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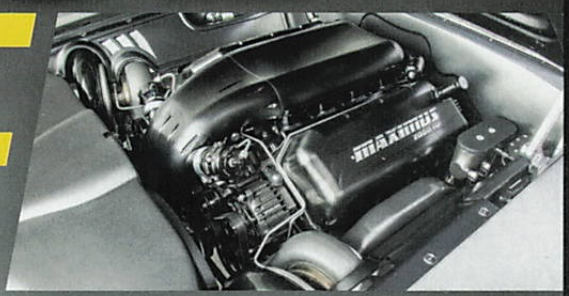

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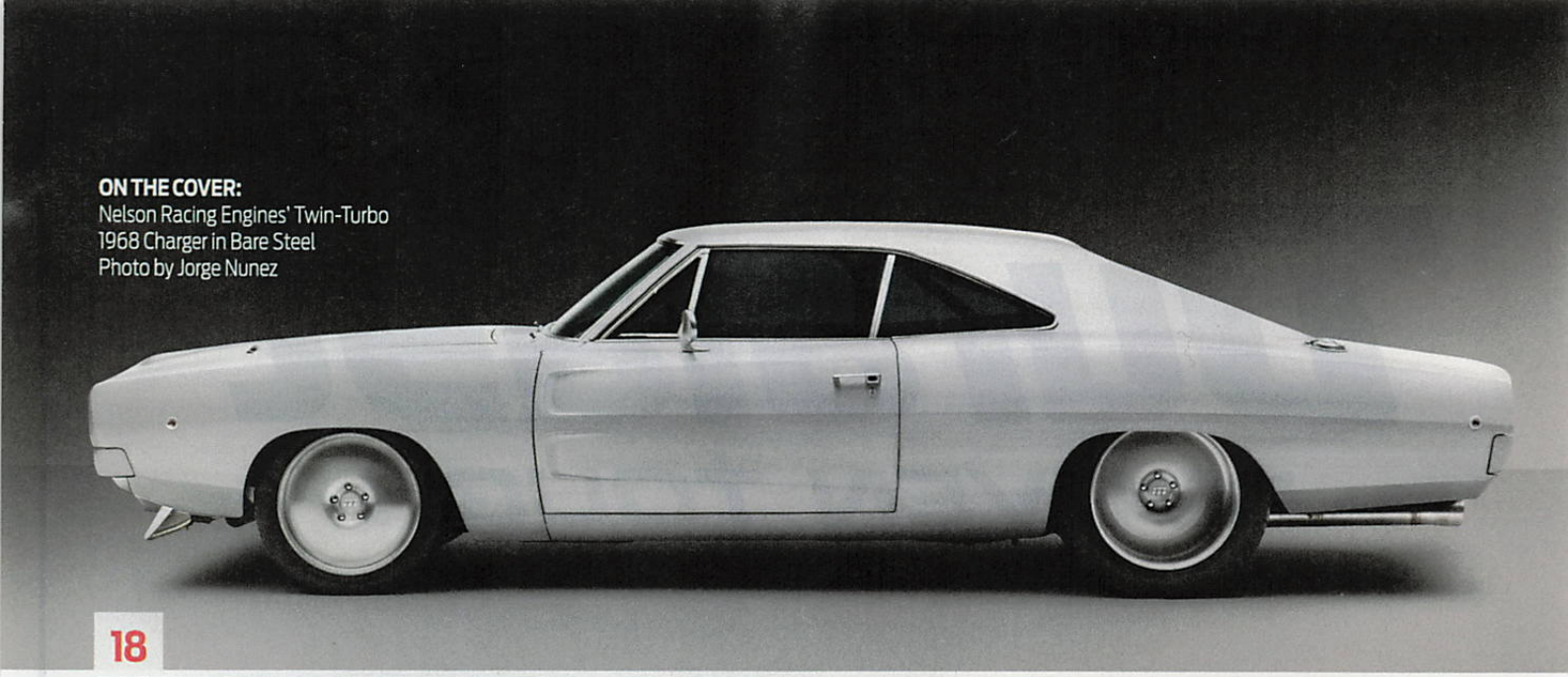

ON THE COVER:
Nelson Racing Engines' Twin-Turbo
1968 Charger in Bare Steel
Photo by Jorge Nunez

18

28

36

Contents

07] Starting Line with John McGann
08] Second Opinion: Like Tools? More Tool Stories
10] Where It All Began: Speed Parts Hall of Fame
12] HOT ROD 20, 40, and 60 Years Ago
14] Take Five With Detroit Speed Founder Kyle Tucker
16] Automotive Archaeology
18] Scott Spock's Stunning Bare-Steel Charger
28] '58 Plymouth With the Blood of Christine
36] Freak Alert! 3,424 HP Supercharged Peterbilt
44] On the Scene: The RPM Nationals
48] 800 HP From a Boosted 5.3—Yes!
58] Build a 400+ HP Vortec 350
64] Switching to E85 Made Easy
66] Quick Tech With Marlan Davis
68] Project Car Update: Shop Talk
72] Reader's Tech Q&A
78] Go-Fast Parts for Your Ride
86] In the Words of Freiburger...

44

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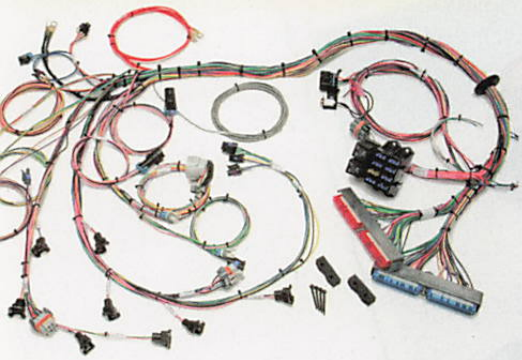

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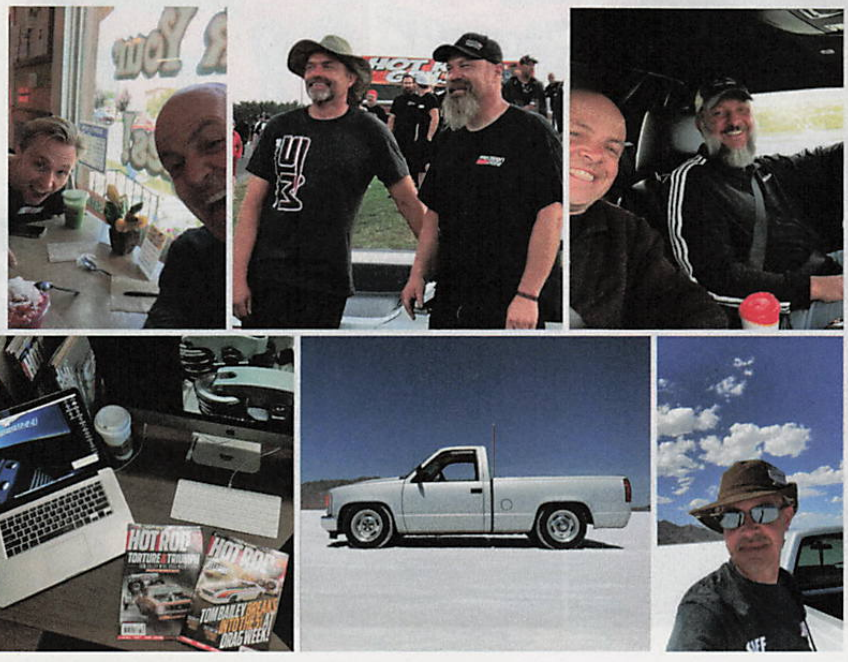

One More in the Books

By John McGann

Editor-in-Chief
@john.mcgann

On one of the eternal mysteries of the publishing world, this, the April 2020 issue, is actually in production at the end of December 2019. You'll forgive me, therefore, for this retrospective look back at 2019 as the calendar year winds down.

As always, this memorial is a tale full of ups and downs, triumphs and tragedies—well, as much tragedy as one can experience when writing about cars, which isn't that bad, relatively speaking. Let's start with the fun stuff. One the most memorable events for me this year was witnessing Tom Bailey break into the 5's at Drag Week. The historic 5.998 at 250.46 mph pass came at the end of the last day of competition, well after it was clear he had a good enough average to be declared the overall winner of the event. Not content with his performance throughout the week, Tom, and co-pilot and engine builder Steve Morris, lined the Camaro up for one more crack at the tree. I was right there, trackside at the 60 ft. marker, when the amber lights flashed and the car rocketed down the track. I've photographed enough drag racing to know when a car is on a really good run, and this one had all the right elements. The car plain hooked off the line—the tires were clawing for traction, and the turbos were fully spooled. Tom never lifted, even as the car drifted off-center slightly as he blazed a path into our history books. For several days after I'd replay videos of that run, listening to David Freiburger's unrestrained excitement as he narrated the run on the track's PA system, and the roar of the crowd when the scoreboard flashed the monumental e.t. and trap speed. It's hard to comprehend what Drag Week has done for the industry—pushing valvetrain technology and builder/driver ingenuity to the point where a car that can drive 800 miles on freeways and in traffic, then rip off a 250 mph pass at the drag strip. It's humbling to be part of the endeavor, even in my own small way. Photographer Wes Allison caught the drama and veteran racer/journalist Mike Galimi penned the words that ran in the February 2020 issue.

Some personal highlights include being invited to the unveiling of Joe Rogan's Nova. Built by Pure Vision Design and photographed in bare steel for our April 2019 cover, the car was an intoxicating blend of design elements I wouldn't have thought would have worked, at least until I saw it in person. It's a pure coincidence that another bare-steel car graces this April cover, the 1968 Charger built by Nelson Racing Engines. This is another instance where, if you described what was done to the car, you'd probably recoil in horror, "They widened the car by three inches? It's got to look like a clown car!" Thankfully, it does not. Please take the time to study the pictures in the accompanying feature this month. The metal work is spectacular.

The One Lap of America has been a bucket-list item for me since I first read about it more than 20 years ago, before I ever got a job here. I got to cross that off my list early last spring, and it was as good as I hoped. I was copilot to Mike Musto, regular HRM contributor and One Lap veteran. We bonded over caffeine, above-average road food, long days, even longer drives into the night, and in admiration of the hard-core racers who participate in events like this because they can. Read our One Lap Coverage online and in the December 2019 issue.

Mike and I joined forces again for the 2019 Power Tour where he was my copilot in our road-sofa Chevrolet Suburban as we documented our week-long road trip with photographers Wes Allison and Povi Pullinen. Over that event's 1,200 mile journey we also discussed the merits of jorts and New Balance tennis shoes, boomers in automatic transmission Corvettes, and the next generation of automotive enthusiasts, while hunting down Yerba Mate in rural Indiana for our health-conscious photog. I couldn't have asked for a better crew. Power Tour was documented in the November 2019 issue.

Wes Allison guided me through the mire of the soggy Bonneville Salt Flats for Speed Week, an event I'd never attended even after 15 years with the magazines. Despite the unsavory conditions, we managed to get some epic pictures, and I enjoyed the solitude of an off-the-freeway road trip to and from the event. Wes' picture made the cover and I penned the words in the January 2020 issue.

Not all news was good, and this year saw the closure of the majority of our print publications. This hit close to home, as I saw the shuttering of *Car Craft*, a title I devoted 12 years of my life to. Lots of the production staff lost their jobs, and the future of the editorial staff is in flux. As the saying goes, the only constant in life is change, well, that and death and taxes. The titles will live on at HotRod.com, so please join us there as we blaze a new path online.

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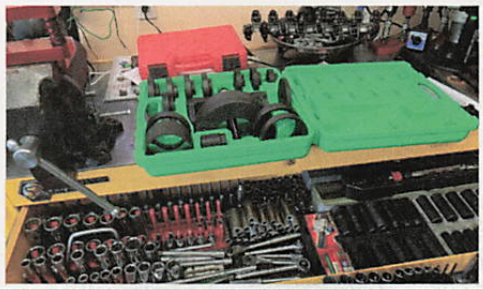

Like Tools? More Tool Stories.

By Douglas Glad

Network Content Director
@douglas.glad

I have no clue where I first saw the word Duralast. It was likely dangling from a string in the center isle of a chain parts store where I was buying a drain pan or a bottle of antifreeze. As a rule, I avoid parts stores for the simple reason that most of my cars aren't stock and the supply-chain systems are designed for factory hardware and part numbers. Parts stores are usually handy for late-night breakdowns and a bag of peanut M&Ms.

There are cars in the fleet that are stock. When they need repairs, I fall into the bracket of DIY guy in the strictest since of the word. I don't send the daily drivers to local mom-and-pop shops, and despite being on the robocall A-list, don't take them to dealerships either. That leaves me in the netherworld between buying dealer-markup replacement parts, gambling online, or going to the local chain store. The Gen Z word for this situation is "cringy."

My solution was to visit a local crime-syndicate/auto-parts store where they had what I wanted, but often with dubious sources. It was a 50/50 proposition that the parts weren't changed in some subtle way that rendered them useless. And I couldn't be sure that children weren't chained to a conveyor belt somewhere building the parts.

I recently learned, without trying, that Duralast is a national brand for professional independent and franchise repair shops and big-box tire stores. If you know anything about how these shops operate, you know owners can't afford comeback work because a new part failed. It's this survival of the fittest atmosphere that keeps parts-supply houses on top of the parts they deliver. Bad parts equal no business.

To compete in this arena, Duralast supplies Original Equipment Suitable (OES) or OEM replacement parts. Instead of a part that mostly looks like original equipment and happens to fit the vehicle, these standards require that the part be year, make, and model specific with factory formulations, design, and fitment. In a world of cheap replacement parts, this was a real discovery for me.

If you are a professional, you can sign up for a commercial account at AutoZonePro.com and have a local rep visit you and onboard your shop. The account includes a service team, a large catalog of parts, and jobber pricing dependant on the program level you sign up for. By ordering online or by phone, the parts will arrive at your shop within 30 minutes.

If you are a DIY guy, you can order the Duralast level of parts online at AutoZone.com, and have the parts delivered to your house or shop with discounts provided by the rewards program.

I also discovered that you can get tools through these guys. Not chrome vanadium garbage, but actual tools like high-end dealership scanners, American-made spring compressors, or even those OEM fuel-connector tools that are impossible to find.

Since I am not a professional, I was able to hit the Tool & Equipment Quarterly catalog online at AutoZonePro.com and fish for the pro-level tools, then order the good stuff through the local brick-and-mortar parts store. Its like a secret handshake.

Is this the solution that covers the delta between dealership markups and sketchy online or local rebuilt parts for the daily driver? I'm thinking it is.

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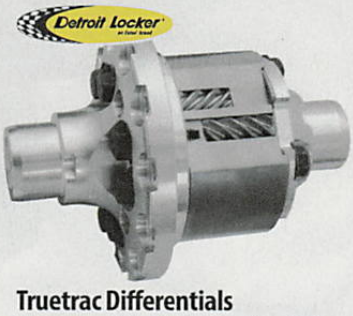

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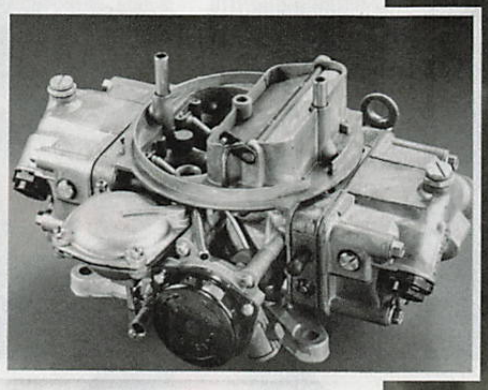
SPEED PARTS HALL OF FAME



HOT ROD's objective has always been to cover what's happening in the hot rodding world—the people, the trends, the races, the culture, the cars, the builds, and so on. But sometimes we're about spotlighting what's not happening, and at one point, it had to do with speed parts. Sure, we'd been featuring them on the pages for 60 years, since the Jan. '48 issue's "Parts with Appeal" showcased a fuel pump. The problem as we saw it was that, to date, there had been no hall of fame for the aftermarket parts that helped to build an industry. HOFs did exist, such as the Automotive Hall of Fame and Motorsports Hall of Fame, but there was nothing for speed parts.

That prompted the Speed Parts Hall of Fame, which first appeared in our Dec. '07 issue. These were not new products; rather, this was about looking back at the ones that were insanely innovative at the time and maintained their level of importance through the decades with both the industry and enthusiasts. The HOT ROD staff landed on 30 products that we felt qualified. That list was then sent to every SEMA member—SEMA being the trade association made up of manufacturers, retailers, builders, distributors, and race teams—as well as to industry insiders, to cast their vote. Write-in candidates were allowed.

Once the votes were in, the 10 most significant speed parts in history were named. Known as the Speed Parts Hall of Fame, the first inductees were: American Racing Torq Thrust wheels, AutoMeter Monster tachs, Bell helmets, Crager S/S wheels, Flowmaster mufflers, Hilborn Fuel Injection, Holley 3310 carbs, Hurst four-speed shifters, Iskenderian Cams, and M&H Racemaster tires.

The Speed Parts Hall of Fame would go on to gain five new inductees annually, with the Class of 2011 the final group. **›Tori Tellem**

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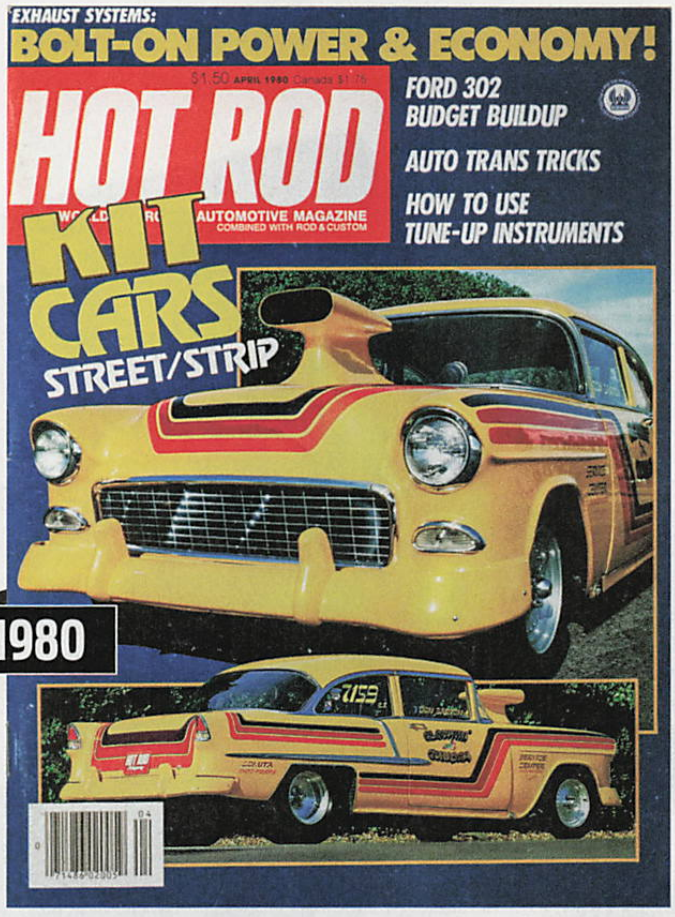

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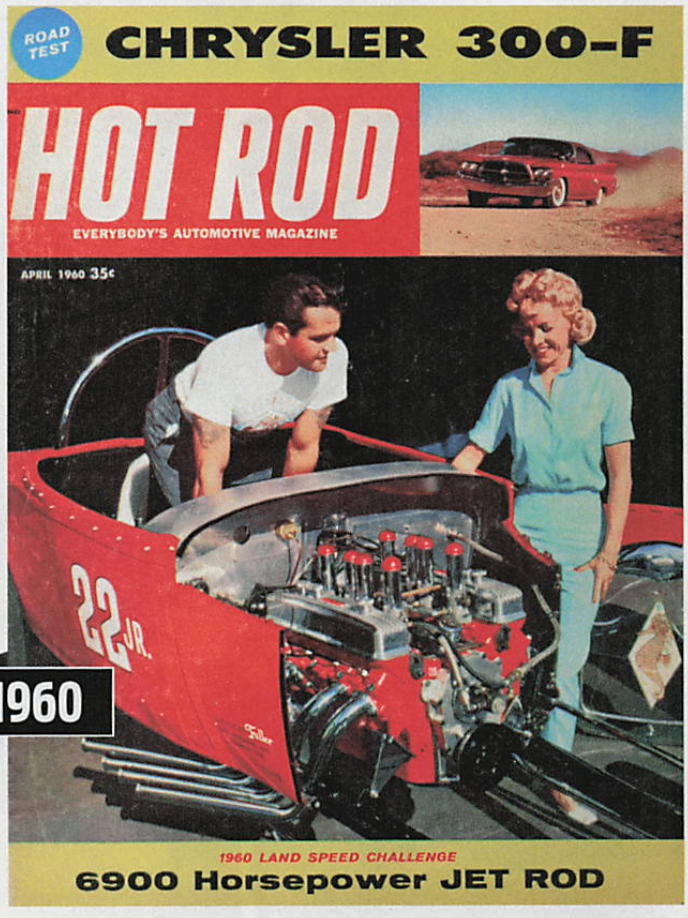

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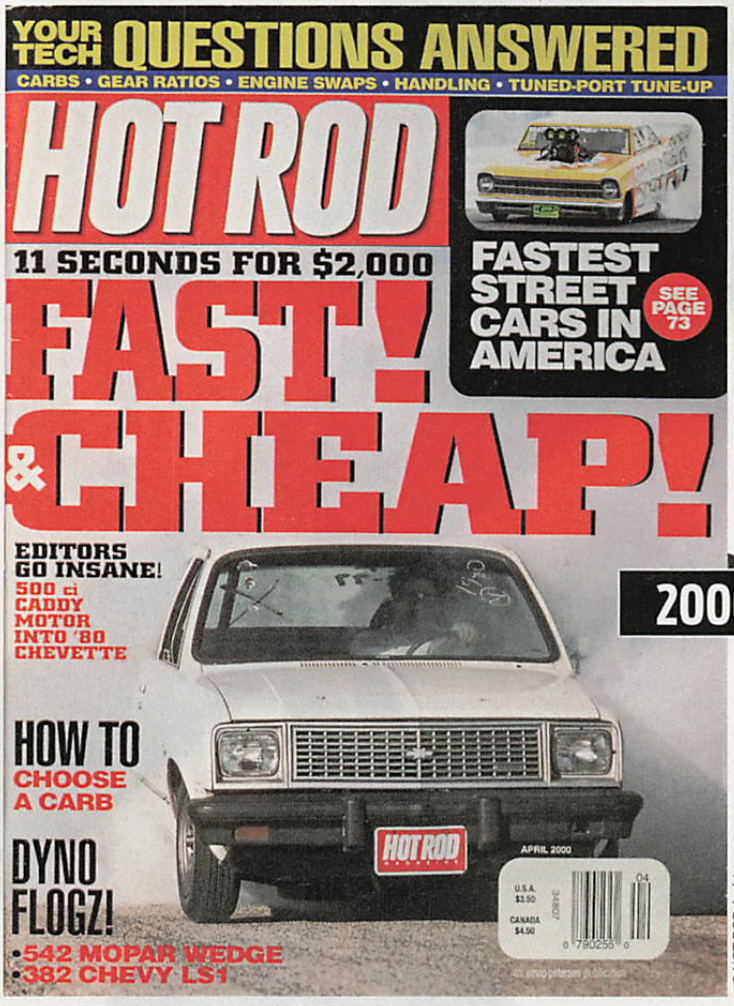
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20 YEARS AGO

(April 2000, 154 pages, $3.50): Eleven seconds. $2,000. Fast. Cheap. Any of those on their own is winning, but we put them all together in one issue, including the Fastest Street Cars in America Top 10 Shootout, a bigly 500ci Cadillac engine in a tiny Chevette, how to pick the right carb, and a 13-sec blown Buick, for starters. Who is Art Chrisman? Answers on that, too.

40 YEARS AGO

(April 1980, 128 pages, $1.50):

"The 1980s will be a most difficult period for the automotive enthusiast," proclaimed Editor Lee Kelley at the start of the issue. Government regulations and gasoline prices were of concern. That's insight into why "economy" got an exclamation point on the cover. Kelley also had great worry that the aftermarket industry would implode from all this scrutiny. Fortunately, the April issue wasn't all gloom—we explained rods and pistons and how to do easy tune-ups, spotlighted a Ford 302 that was built on a budget, completed assembly of our V8 Vega, and showed off an all-steel '32 two-door, blown Camaro, and a '29 A roadster, among other cool cars. Also, "Dyno" Don Nicholson spoke to us, including about driving a Chevy.

60 YEARS AGO

(April 1960, 122 pages, 35¢):

There was good news in this issue: "Roadsters aren't dead yet by any means!" said Editor Wally Parks. Good thing, since that was Tony Nancy's Buick-stuffed one on the cover. Same good news for stock cars, according to Wally. Camber, instrument usefulness, the 300F, retainer rings, "the hottest rod of all time," and an award-winning Phaeton were among the many bits and pieces in the issue. **›Tori Tellem**

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Take Five With KYLE TUCKER

Former GM Engineer and Founder of Detroit Speed Discusses Performance Aftermarket Manufacturing in the Modern Era

© Courtesy of Detroit Speed

Engineers notoriously know at least six or seven workable answers to any question put in front of them. What separates a good engineer from an okay one is the ability to recognize which of those options is the best answer. But Kyle Tucker isn't merely a good engineer he's a great one, and that greatness lies in his ability to get to the ideal answer quickly, turn it into a tangible and practical product, and deliver that with almost insane efficiency, into the hands of consumers. Tucker grew up on a farm in Missouri and attended what is now Missouri University of Science and Technology (MUST) in Rolla. It was a must, while studying mechanical engineering, that he meet Mark Stielow. Yes, that Mark Stielow, the guy whose series of first-generation Camaros have set the standard for Pro Touring cars for more than a quarter century.

Alongside Stielow, Tucker started his career at General Motors working in development at the Milford Proving Ground. But while corporate life has its rewards, he had his eyes on something different. Moving on his passion for Detroit iron, he began developing parts for a 1969 Camaro he was building in his garage at home. The passion quickly became a business, with customers wanting his custom-designed components. With the help of those early customers, Detroit Speed Inc. was born.

It used to be if you wanted to make your muscle-era monster get around a corner, you grab-bagged some shocks and springs and hoped for a miracle. Kyle Tucker is one of the pioneering people who changed that.

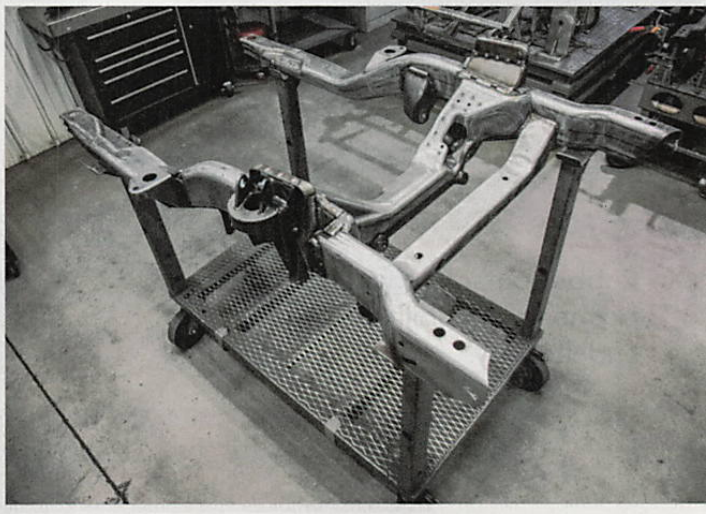
Oh yeah, Detroit Speed is now located in Mooresville, North Carolina.

HRM] How long has Detroit Speed been around now?

KT] We incorporated in December 2000, so we're coming up on 20 years. It seems fast and scary and there's something new every day. Today there are 55 people working at Detroit Speed. The design, engineering, and manufacturing of chassis and suspension components is the biggest part of the business. The car builds are oftentimes what we're known for. It's a smaller part of the business, but it's important because it's good for marketing. It's good for us because we're gearheads who like to build cars, and it means we're like our own customers. It's a good balance for us. It's a good way to identify new products and to check our components as they go on the car.

HRM] What comes to mind first about Detroit Speed is the hydroformed subframerails for the early F-cars. Was that the breakthrough product for you guys?

KT] That's still the flagship product for the company, and it's the biggest project and investment



that we've had—to engineer that and invest in the tooling to be able do that. We're the only ones in the aftermarket to do hydroforming, especially on a framerail.

HRM] GM uses hydroforming on a massive scale to do its truck frames and other things. It's a complex process and specialized technology. Is it difficult to do it on a smaller scale? Is it something other aftermarket companies should be doing? Why are you the only ones doing it?

KT] It's a combination of things. Maybe I'm the only one dumb enough to take the risk, because anyone else looking at it from the standpoint of volume in the aftermarket, probably would have been scared. For me, it's just the right way to do it. I'm not dissing on competitors, but how is our suspension geometry supposed to be better than someone else's? The frame is just as important as any other element. As you fabricate framerails—when you

bend 4x2 rails—you get a thick side and a thin side, or you get a heat-affected zone. Hydroforming was the natural solution, and it's why the OEs do it.

When we were in Detroit, I worked with some prototype vendors; vendors who support prototype volumes for the automotive industry, so they're not feeding production lines, they're doing prototypes. They build hundreds of those, not millions. It was a good fit for me to hook up with prototype vendors with whom I've been doing business for 19 years now. I do it on what they call soft tooling, not hard-steel tooling. It's typically Kirksite material, which is 97 percent zinc, so it's castable—you can melt it down, you can make a new tool out of it. It's good to support prototype or aftermarket volumes.

HRM] It seems you're still using the knowledge base you built up while working at GM. Are you still in contact with the same people you worked with there?

KT] I still stay in touch with guys like Mark Stielow, and we were buddies before we got to GM because we were in engineering school together. My GM career, although it was fairly short, was on the development side of things and never manufacturing. I got to know some spring and shock vendors, but I never was involved with the hard tooling. It was just being in Detroit—like anywhere—you get a network around you. In Detroit, there are networks upon networks of car people; it's a real rich environment.

HRM] Stielow is high-profile in the world of hard-core F-bodies. How important has his input been to your business?

KT] Mark is a smart guy, an engineer and a racer. He's been influential in the business, like the wiper kit. That was Mark engineering a widget for his car, but it wasn't anything he could make two of, much less hundreds of.

HRM] So why aren't you still in Detroit?

KT] I wasn't from Detroit. I grew up in southern Missouri and went to Detroit as a college co-op, and of course landed a job at GM. I learned a lot, but as Detroit Speed started to grow—we were building cars for customers, which was the primary business when we started, because I didn't have any money to build parts. As the company grew, commercial real estate prices were prohibitive to buy a place. I had built a couple of cars for customers in North Carolina, and as we got to know them and deliver their cars, it was a good fit. Weather was a big part of it, and the ability to attract and retain good employees, the quality of life, and the cost of living . . . it was all in Mooresville.

HRM] But you kept the Detroit Speed name anyhow?

KT] Two reasons. We had started to have a little bit of a brand. Also, we still do a lot of manufacturing up there—stampings, forgings, hydroforming—that's all done in the Detroit area. When you think of muscle cars, they come from Detroit, and that's primarily what we do.

HRM] Is there a new market arising for Detroit Speed beyond what you're doing now?

KT] Diversification. The new muscle cars coming out of Ford, GM, and Dodge are really, really good. They're not leaving a lot on the table. There's not much left to do to them. As I look at them, I want to make sure we expand our product lines into the '80s and '90s cars. I want to make sure we're manufacturing strong, and bringing more and more in-house. We do more and more with things like headlight kits that convert to more modern technology and variable-speed wiper kits. That's still a growing market for us. When you build an old car, you forget how much the wipers suck.

HRM] You're getting a lot of attention for the blue third-generation Camaro you built. How much of your business can move to the third-gen? Do people want to invest a lot of time, effort, and money into third-gen cars?

KT] It's growing. Right now, it's a $3,000 to $5,000 car. It's where first-gens and second-gens were years ago. People of the right age, if they didn't have a third-gen Camaro or an IROC, they wanted one. I wanted one. The cool kids and rich kids had one, but I didn't have one. It's generational. Now those people might have some money, and I see people putting money into those cars. If you build a car that's fast and functional, and maybe spend too much money, it leads people to build cars like it.

HRM] So who is your customer?

KT] Most of our customers are still do-it-yourselfers. We have a large retail market, and we like that because we can give them the tech service, the installation tips, because we're car builders too. It's the guy or gal who saves up to do the next project, orders the parts on Monday and does the job the next weekend. We also work with distributors in the industry. Our sales staff can only reach so many people, and Summit Racing, JEGS, and companies like that get to everyone. We need that distribution level, and we deal with them directly.

HRM] What are the best and worst things about running your own business?

KT] It's the same answer. The people are the best part. I love the people we have. Everyone is hand-picked, and I still have my very first employee. But, the hardest part is still the people. Everyone can have a bad day here or there. This automotive aftermarket is about passion. You have to have it in your gut to survive. If you do it right, one: you're going to get business; and two: eventually, you're going to make some money—or at least have a bunch of cool things around.

HRM] You have six mechanical engineers at Detroit Speed now. Will recruiting engineers or hands-on fabricators be more critical going forward?

KT] Some of our hardest people to find are machinists and welders. The tech schools and shop classes have gone away, and college isn't for everybody. We still need a lot of skilled people in this world, and that influences how we design our parts these days because people are not as hands-on. A lot of times they want to buy it instead of build it. Our parts need to be more bolt-on, more friendly, without fabrication required.

HRM] If you had stayed at GM, where do you think you'd be now?

KT] I always wanted to be more on the technical side. That's why I worked at the Proving Ground. I had a hoist, I had a toolbox, and I had hundreds of miles of test track. That met all my requirements. If I'd stayed, I'd probably still be somebody at the Proving Ground as a technical manager or development manager. I still like being hands-on.

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Automotive Archaeology
Stash of Chevrolets Found After Decades

© Ryan Brutt

One day a 1970 Challenger R/T appeared at a house I had driven past for decades, so I had to stop.

Behind the house was an old storage shed that contained a few muscle-car era Chevrolets and an early Mustang shoved in the back corner. Next to the Mustang was a 1967 Chevy II Nova SS. The original engine was gone, as was most of the original front end, but the owner was collecting parts to make it into a drag car at some point.

In front was a 1964 Impala SS with a mostly clean body, apart from some damage to the right rear. It was put on the back burner for other projects: like the 1956 Nomad that was currently residing in the owner's shop, finally being put right.

› Ryan Brutt

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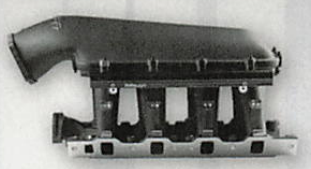

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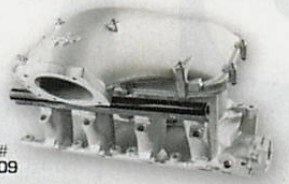

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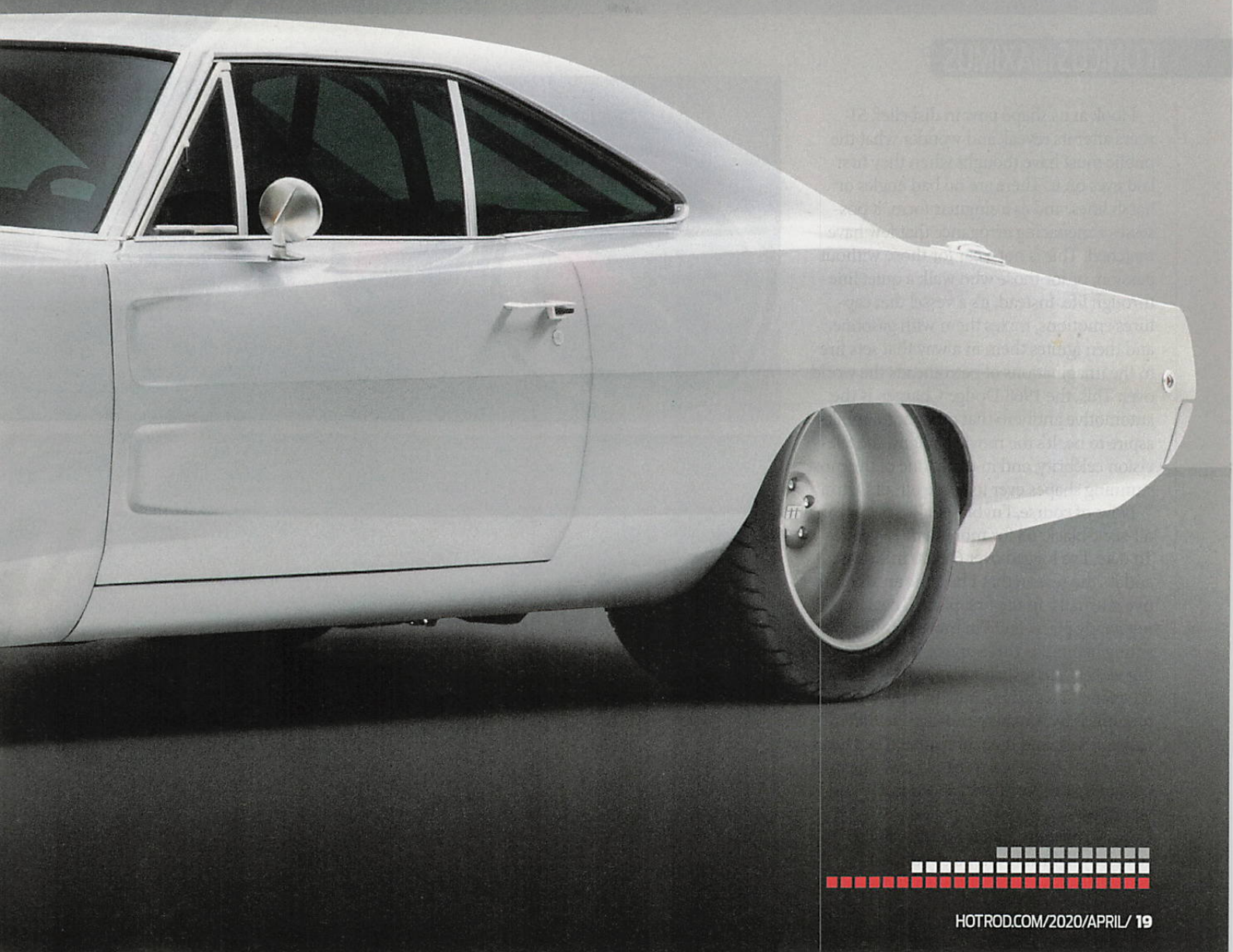
ICONICUS

By Mike Musto Jorge Nunez

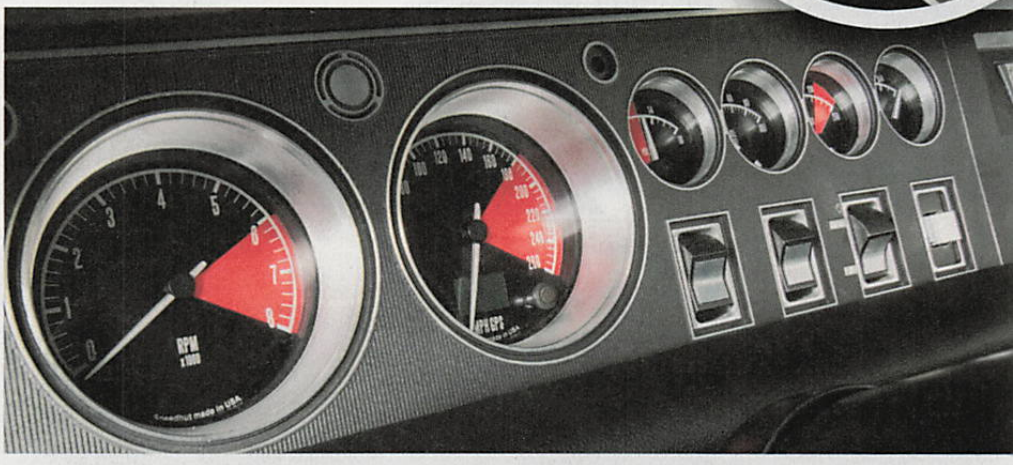
If you were asked to repaint the Mona Lisa, could you do it? If we contracted you to renovate Fallingwater by Frank Lloyd Wright, would you be up to the task? And if you were entrusted to reimagine one of the most significant automotive shapes of all time, would that frighten you? Most of the time, questions like this are hypothetical. Let's face it, the Mona Lisa is priceless, and Fallingwater is an architectural wonder, so it's doubtful anyone is going to make a run at those anytime soon.

But what about that last question—the one about the car . . .

MAXIMUS



ICONICUS MAXIMUS



I look at its shape now in disbelief, 51 years after its reveal, and wonder what the public must have thought when they first laid eyes on it. There are no bad angles or harsh lines, and as a singular form, it possesses a menacing arrogance that few have matched. This is not a car for those without passion, or for those who walk a quiet line through life. Instead, it's a vessel that captures emotions, mixes them with gasoline, and then ignites them in a way that sets fire to the imaginations of petrolheads the world over. This, the 1968 Dodge Charger, is the automotive antihero that other automobiles aspire to be. It's the movie bad guy, the television celebrity, and in truth, one of the most stunning shapes ever to come out of Detroit.

Now, of course, I'm biased; I've owned an oil-slick-black '68 for more than 15 years. To date, I've logged over 65,000 miles on it, and it's the reason that I became an automotive journalist in the first place. That car is my happy place, and I'm more comfortable sitting behind its three-spoke wooden steering wheel than just about anywhere else on the planet. I was captivated by the Charger's toughness by watching movies like *Bullitt*, *Cannonball!*, and then, of course, *The Dukes of Hazzard*, but it wasn't until I saw one in person that the fork was placed in me and I was done.

Music producer Scott Spock was also struck by lightning after a childhood

encounter with a Dodge Charger would, decades later, lead him down a path that he could've never imagined.

Ladies and gentlemen, meet Maximus. An eight-year, 16,000 man-hour, bare-metal homage to one of the greatest muscle cars ever created. This isn't some garage-built restomod or a bolt-on showcase. Instead, Maximus is a one-off, coach-built masterpiece that has been crafted from forged steel, desire, and the will to create the most influential, and technologically advanced 1968 Dodge Charger the world has ever seen.

"This journey started when I was 8 years old as a little kid playing in my front yard. It was in the early 1970s, and this guy comes driving by in a 1968 Charger, and it was the meanest, most incredible machine I'd ever seen in my life. It just stuck with me." Scott says.

Before Scott had the chance to dive into a Charger build though, life happened. Work; family; a career, as well as the rigors that go along with it, placed the Charger dream on hold for a spell. What it didn't do, however, was keep Scott from tinkering with cars. After all, once a hot-rodder, always a hot-rodder.

"I always had a car I would tinker on, and I've always loved Hemis. Regardless of what we worked on, though, I always thought that, 'One day I'm going to find a Charger, I'm going to fix it up, and I'm going to make it something I can drive every day. It's also going to be the most incredible 1968 Charger ever built.' The problem was I just needed to figure out how to do that," Scott says.

Now, this is where the story gets weird, at least for your author anyway, and here's why.

"It wasn't until 2010-2011 that I finally started thinking about the build seriously. I come from the entertainment industry as a music producer, and in the beginning it was tough. I starved until I was about 30, but then had some great success. And it was then, when I was finally in a place where I thought I could make it happen.

"It was also at that time I started looking online, and looking at different builds, and I came across this one fella who had this black Charger called Mr. Angry [the author's car], and it was inspirational to me. There are times you see a particular version of a car that you love and you start to think, 'Yeah, maybe I should do it,'" Scott adds.

See folks! Sometimes all you have to do is drive to get noticed. That's it: Just get out and drive.

Now that Scott was ready to build the Charger, his next quest was to find someone with the skill, knowledge, and track record to pull it off, and he knew his guidelines and ideas weren't going to be easily met.

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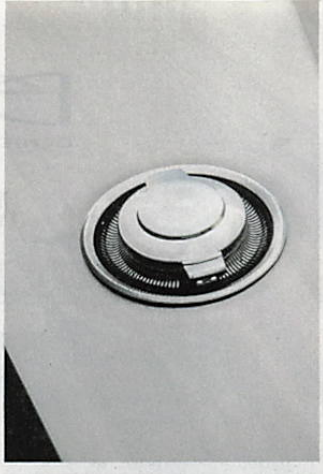
"I'm a purist in one sense, but I kept thinking, 'How can I modify a '68 Charger but keep it aesthetically true so that there's no mistaking it for anything but a 1968 Dodge Charger. By the same token, I wanted people to look at it and say . . . man, I don't know what it is, but there's just something different about that car,'" Scott says.

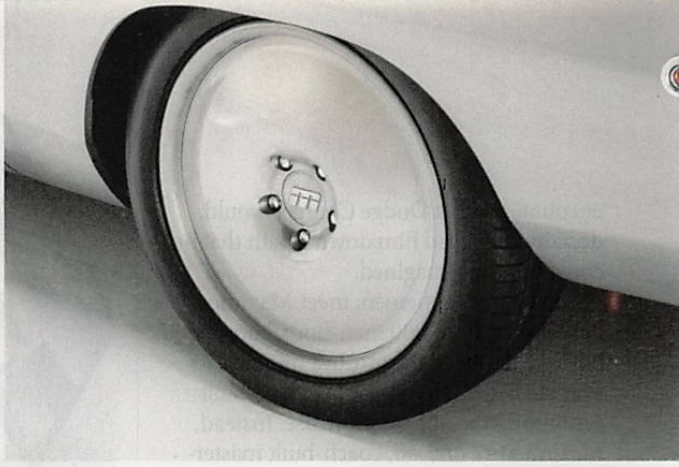
That's when the creative process began to happen—with a vengeance.

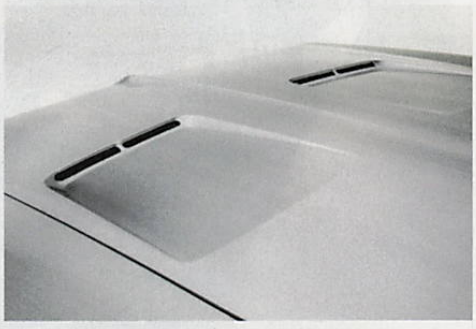
He continues, "I ran my creative approach like I was making a record. When it came to music, I would find the best people in the world—the best guitar player, the best engineer—I didn't care who it was or where they were. If I needed their sound or their talents, I would find them."

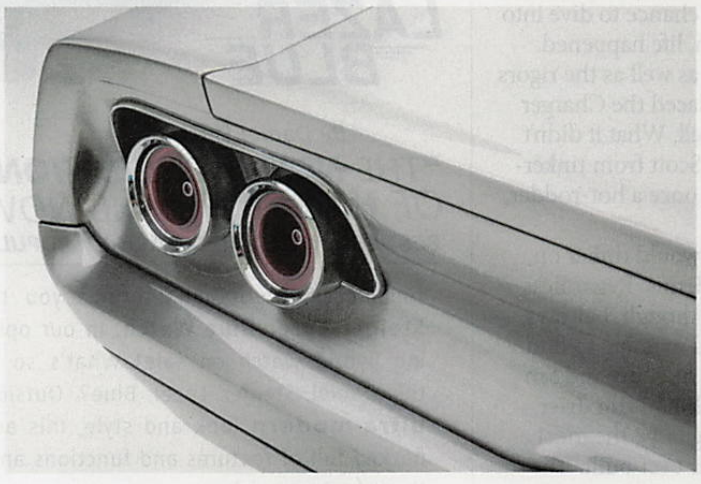
Scott understood the fundamentals of building a car. One just doesn't take a vehicle, shove a big engine under the hood, and then find success. That was a lesson he learned when he built a 426 Hemi engine for his old Chrysler 300. The experience of significant power led to a slew of broken parts. Thus, he knew well before Maximus even began, that everything would be crafted around the engine. But who would build it?

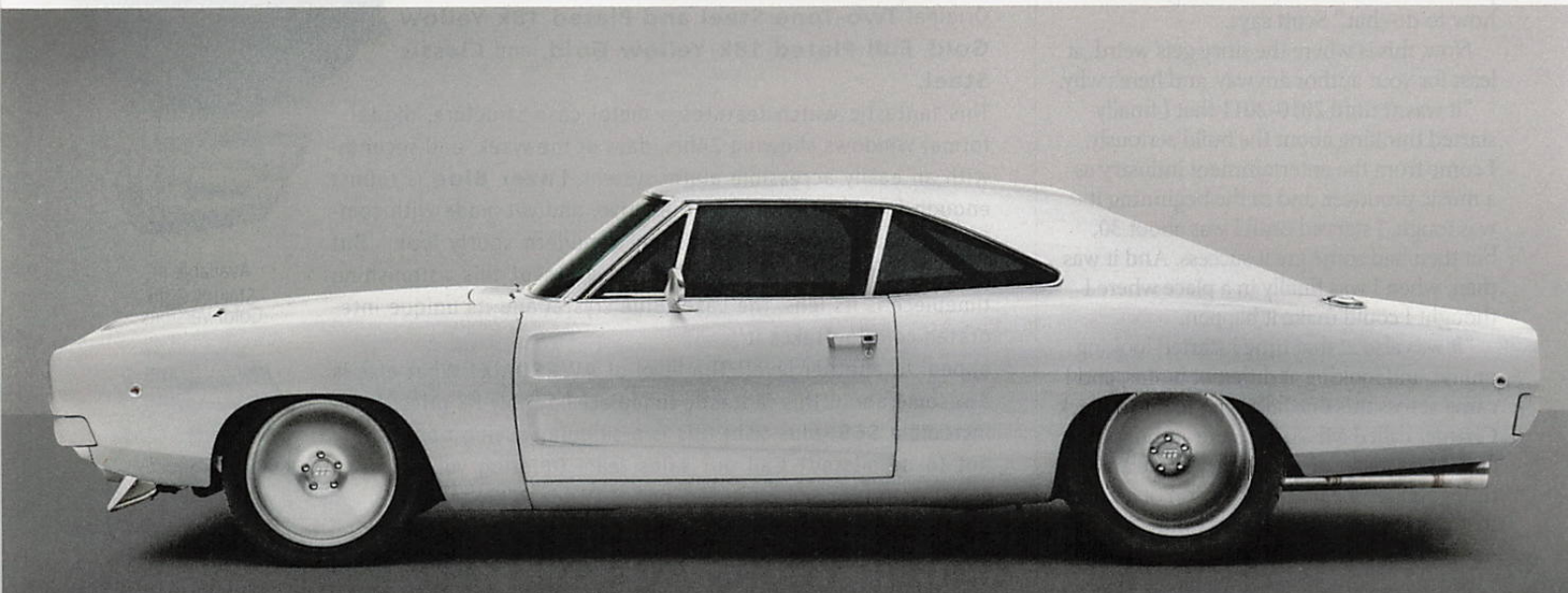
"Back in 2011, cars with more than 1,000 hp weren't that common. You would see some cars on YouTube, but for the most part, you'd call B.S. Then I came across Tom Nelson. He was the only guy that you'd see actually driving the cars and showing real dyno numbers, so I scheduled some time and went to see him.











"I'm a purist in one sense, but I kept thinking, 'How can I modify a '68 Charger but keep it aesthetically true so that there's no mistaking it for anything but a 1968 Dodge Charger.

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At first, Tom was giving me options. He said, 'We can do a 572 Hemi, and you'd probably make around 2,000 hp, but that's really over the top, but if you want to do a daily driver, let's just keep it to a 426, and we'll make like 1,200 hp.' While logically that was great, I just kept thinking, 'Yeah … but 2,000 hp, that's, that's just intoxicating!' That's what Tom does—he dangles the carrot in front of you and makes your imagination go berserk!" Scott exclaims.

So now Tom Nelson of Nelson Racing Engines was involved. For those who don't know Tom, let me summarize: Tom is the guy you go to when 1,000 hp in your daily driver isn't enough. He's the guy responsible for David Freiburger's 1973 F-Bomb Camaro, complete with its 1,500+ hp twin-turbo 406 small-block. NRE also did the ProCharged 500 cubic inch Mopar Wedge in Steve Strope's Hammer Road Runner, as well as the 1,800hp, twin-turbo 427 small-block that lives under the hood of Randy Davis' 1984 Camaro (plus many more). No joke, Nelson Racing Engines knows horsepower; how to build cars; and more importantly, how to make them reliable and usable daily.

Things were set in motion, and the search for a donor car began. Found in Southern California, Scott freely admits that the donor car was a complete disaster when initially purchased, but it came with a part that's almost unobtainable in the '68 Charger world—a perfect grille. While he knows he overpaid for the car, he also noted that it was precisely what was needed to get the process rolling; and so a ragged, old Charger was delivered to Nelson Racing Engines in Chatsworth, California. Once at the shop, they began taking stock of what they had to work with, and the mad-scientist phase of the project started.

Tom Nelson picks the story up from here, saying, "Originally, it was going to be more of a Pro Street Charger. Always planned as a twin-turbo Hemi, but for the most part, it was more or less going to be a bitchin' bolt-together car. We had a plan and started sand-blasting and cutting the car apart, then we put it on the frame table—this is where the biggest change in Maximus came. We had initially gone out and bought a 345/35-series rear tire, but when we put the tire under the car, Scott wasn't really saying anything, so I could tell he wasn't stoked. I asked what was wrong, and he simply said, 'It looks weak.' That's not exactly what you want to hear when you're building a car for someone."

In case you were wondering, a 345/30-series tire is a lot of rubber. For reference, a 2017 Dodge Viper ACR runs a 355/30-series rear, a 2019 Porsche GT3 RS has a 325/30, and even a new Lamborghini

"Yeah... but 2,000 hp, that's, that's just intoxicating!' That's what Tom does—he dangles the carrot in front of you and makes your imagination go berserk!"

Scott Spock

ICONICUS MAXIMUS

Aventador wears a 355/25. Thus, implying that a 345/35-series looks weak, well, that's just looney. Then again, it also gives you an idea of where Scott's head was.

"When Tom put the tires on it, I just thought, 'Man, it's not right. It's not what I was thinking.' I told Tom that I wanted to get a bigger footprint out back because I knew we'd be making at least 1,500 hp, but he said, 'That would be great, but we just don't have room.' So I just said, 'Well, what if we widened it?'" Scott says.

At this point, Scott began to worry, as the one thing he was adamant about was that the car *always* had to be fully recognized as a 1968 Dodge Charger. Scott suggested the car be widened, but the question was, how? Tom came up with the idea that would not only enhance that beautiful Coke-bottle shape but also allow it to run some mammoth rubber outback. The plan was to begin the widening process at the doors, then angle it back for a 3-inch width increase on each side. While onlookers would notice something was indeed different, the change would be so subtle that only a trained eye would pick up on it. Then there was the question of the tire's sidewall, because, let's face it, large cars like the Charger just look better with more sidewall. After some calculations and mock-ups, a final decision was made resulting in a one-off set of Bonspeed wheels. The rear wheels were 20x18 with a set of 30x20x18 Mickey Thompson tires, and 9x11front wheels with a more modest

275/45-series Pirelli P Zero. Did the widening process add a few extra years to the journey? It sure did, but what a difference it made on the finished car.

At this point, we're significantly oversimplifying how Tom and the guys at NRE widened the car, because if we went into detail it would fill a book. Suffice it to say, the process was excruciatingly time consuming and resulted in the Charger becoming a full-on, coachbuilding experience. And remember, this was just the body. We haven't even touched on the propriety designs of the engine, chassis, suspension, interior, electronics, as well as the biggest cannoli in the room—the decision to leave the car in bare metal.

Moving on. We're years into the build, and under the hood sits a 572 cubic inch Hemi (that's 9.4L) that utilizes twin NRE 88mm turbochargers, twin intercoolers, and a computer-controlled dual-injection system that switches automatically between 91 and

116 octane fuel when the octane threshold is reached. In the trunk is a dual-reservoir fuel tank that was CNC'd from a solid 2,000lb block of aluminum. The tank features internal baffling, rollover vents, as well as all the plumbing. It is a sculpted work of art. The verified horsepower and torque numbers on Maximus are also mind-bending: 2,253 hp at 6,200 rpm, and 1,927 lb-ft of torque at 6,000 rpm—and this is at just 25psi of boost. Tom claims that if the boost pressure is increased to 45, power output would be just shy of 3,000 hp, making it the most potent Street Hemi that NRE has ever produced.

Did we mention all this power is going to the rear wheels via a highly-modified Tranzilla TR6060 six-speed manual transmission from Rockland Standard Gear Inc.? Well, it is, and it's something we find hilariously irresponsible—in the best way imaginable. For those with doubts, don't fret, because Maximus has a built-in GPS-based traction control system to keep that power in check, as well as a five-mode horsepower/boost controller switch that lets the driver toggle between 1,000 and 2,000 hp. It's really quite mad, actually.

of *Furious 7*. The problem was that we were still working on the car and it hadn't even run yet! But we scrambled and got it going.

Once the movie came out, everybody online was saying, 'No, don't paint the car, it looks so cool in metal!' That was the hardest decision I made. I always wanted to paint it black, but I realized that it would be really cool to keep it in metal. When I told Tom, he said, 'You do realize that doing that will add years to the build, right?' But we did it, and now look at it! I'm both proud and scared of it, because we really did create a rolling piece of fine art," Scott says.

Tom explained to us that the major purpose of Maximus was to showcase to the world that NRE builds more than just engines. As it stands, NRE has 22 full-builds going on, with Maximus being their current magnum opus. All you have to do is look at Maximus to see why. Simply stated, it is impossible to hide flaws on a bare-metal car. When the vehicle is viewed in person, one has to marvel at the skill and craftsmanship of the exterior metalwork.

As for the interior, that could be the subject of another book, as every surface,

I'm both proud and scared of it, because we really did create a rolling piece of fine art,"

Bestowing the biggest booty in history on the backside of a Charger wasn't without issue, though, as it meant fabricating an entirely new frame and suspension system.

As Tom describes it, "If you put a 30-inch tall tire on and try to get the car sitting low, the rear tires would be sitting on the rear framerails, so if you had to make it fit without modifying it, the thing would look like a 4x4. We actually cut away the entire back end of the car, and handmade the rear framerails and the entire rear suspension. It's completely our own design, as is the front, which uses adjustable coilovers with a custom rack-and-pinion with modern geometry. The rear end is a big-tube 9-inch that's completely reinforced, has 35-spline street axles, a 1350 yoke, and a Nodular center section. Everything was done in solid works, then we would water jet the parts. There is nothing on this car, in regard to the suspension, that was purchased—it's all NRE."

At this point, the car was assembled enough to be put on display at the 2013 SEMA show, and with that, came the next step in the evolution of Maximus. Keep in mind that while the car was showcased in bare metal, it was never meant to be a bare-metal build.

"The crowd simply loved the car in bare metal, and then Dennis [McCarthy, vehicle coordinator for the *Fast & Furious*] saw it and said it would be perfect for the ending switch, button and vent, relay, and trim panel is a bespoke piece that's unique to Maximus. To give the briefest of examples, a stock Chrysler stereo from 1968 now sits on a rotating James Bond-style panel that electronically flips over to expose a modern touchscreen. The steering wheel, which at first appears stock, is actually a billet piece covered in hand-stitched Italian leather with hidden buttons on the rear of the spokes that control many of the car's functions. Then there's the center console, with its rotary boost knob and toggle switches. It looks so good; it'll make you rethink why all consoles aren't designed this way.

Maximus is a masterstroke of automotive art and engineering, and one that answers the age-old question, "what if?" From a technological standpoint, it was designed to be updatable as our technology evolves, and from a power perspective? Well, the rest of the world can just play catch-up at this point.

Now, after eight years and 16,000 man-hours, only one question remains. In 20 years, will Maximus simply be known as an actor in a Hollywood car movie or, will owner Scott Spock jump behind the wheel, carve out his own legacy, and thus be known as the guy who drove the wheels off, what is perhaps, the most significant 1968 Dodge Charger ever made?

It's your move, Scott. It's your move.

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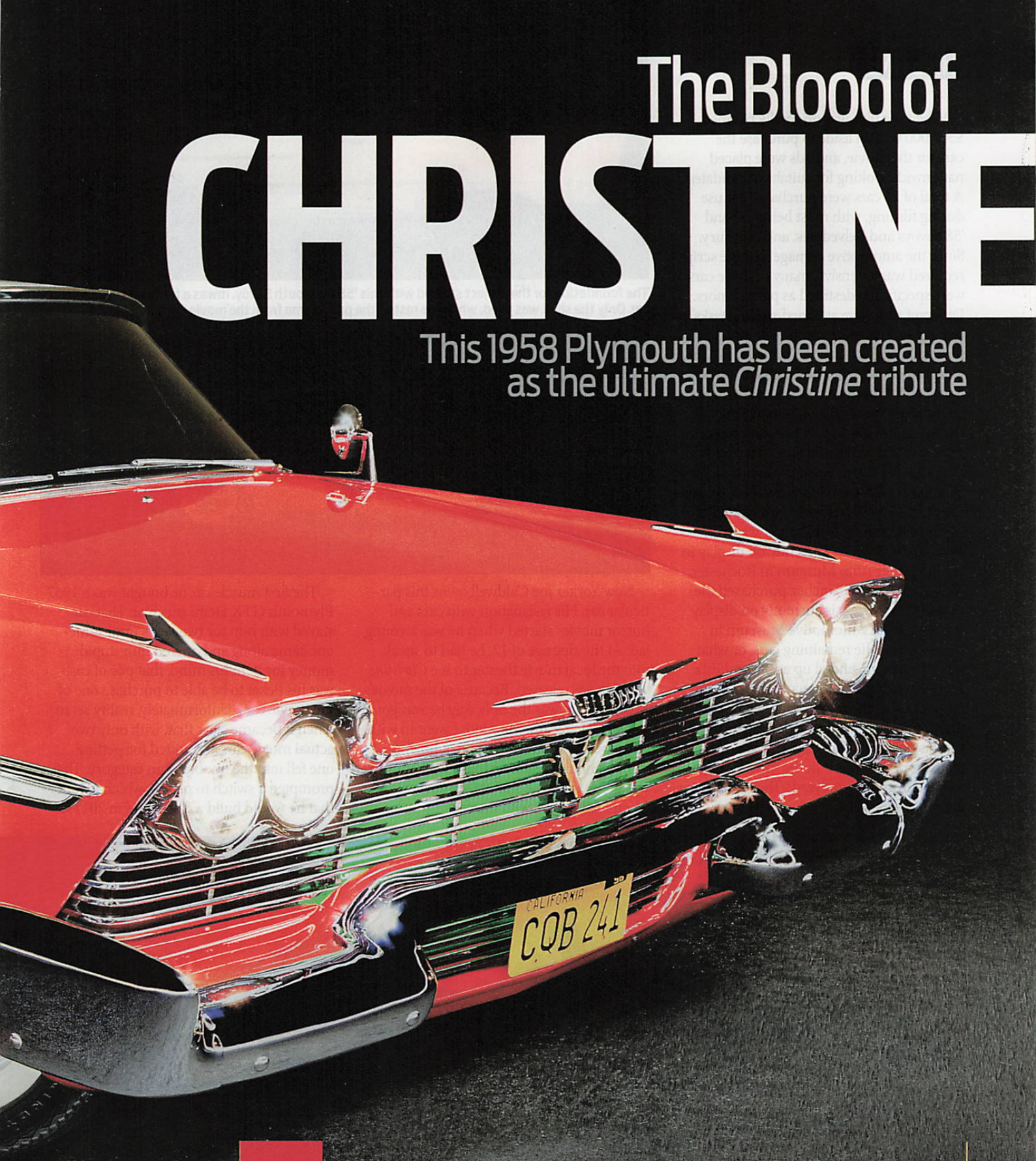
Right Main: Built from the remnants of some of the cars destroyed in the making of the movie Christine, Joe Caldwell has assembled the closest clone of an actual movie car.

Above left: This is a vintage photo taken in 1983 right after the cars were sent to the salvage yard. This particular car was used in the final scenes of the movie when the bulldozer ran it over.

Above right: This is a vintage photo of one of the three incomplete cars pulled from the salvage yard. This was put together from parts pulled from some of the other cars. In the end, it was parted out and was responsible for about 60 percent of the parts that Joe would eventually use on his Christine.

The Blood of CHRISTINE

This 1958 Plymouth has been created as the ultimate *Christine* tribute

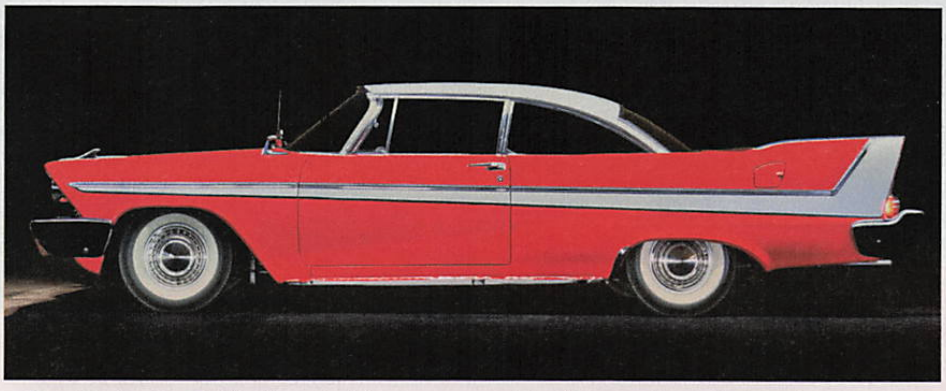


What's not to love about an automobile that fixes itself and can dispense some justice to your enemies? If that brings a specific car to mind, then you're probably thinking about the demonic 1958 Plymouth Fury used in *Christine*, John Carpenter's cult-classic horror movie based on the Stephen King novel of the same name. While King's novel was a huge success, the movie didn't get the same kind of love. It opened on December 9, 1983, to lackluster reviews and poor attendance at the box office. It has gone on to be one of the most iconic horror and car films ever produced, however. Cast with relatively unknown actors, and what King described as a "forgotten car," it cemented the 1958 Plymouth Fury forever on the automotive landscape with a huge worldwide following. As a result of the popularity of the film, it has spawned many Christine clones, yet only a handful can lay claim to actually being used in the movie.

John Machaqueiro John Machaqueiro, Aaron Kahlenberg, Joe Caldwell

When the film was originally planned, $500,000 was set aside to purchase the cars for the movie, and ads were placed nationwide looking for suitable candidates. A total of 24 cars were purchased for use during filming, with most being '57 and '58 Savoys and Belvederes, and one Fury. Since the automotive carnage that the script required was extensive, many of those cars were specifically destined as parts donors. Different cars were assigned specific tasks in the movie, and when filming wrapped up, three survived intact. One was sent to MTV to be raffled off. After it was given away, all traces of it disappeared to this day. Another one was sent to a radio station in Simi Valley, California, as part of a nationwide promotion to be awarded on New Year's Eve. That car ended up in the hands of Scott Edminster and was relocated to New Hampshire until 2004, after which it was sold at Barrett-Jackson to Ron Pratt. It was sold again in 2015, and is currently on display in the Rochester Auto Museum in Rochester, New York. Martin Sanchez purchased the last survivor, which is currently on display at the Petersen Automotive Museum in Los Angeles. The remaining cars, or what was left of them, ended up at Bill and Ed's Auto Wrecking in Fontana, California, after production of the movie wrapped up. At this point you may be wondering what the story is on the Plymouth you're looking at on these pages. Was it in the movie, and also rescued from the junkyard? The best answer to that is—sort of.

The foundation for the project started with this '58 Plymouth Savoy. It was a fairly rust-free Arizona car. Only the shell was used, while the rest of the parts came from the movie cars.

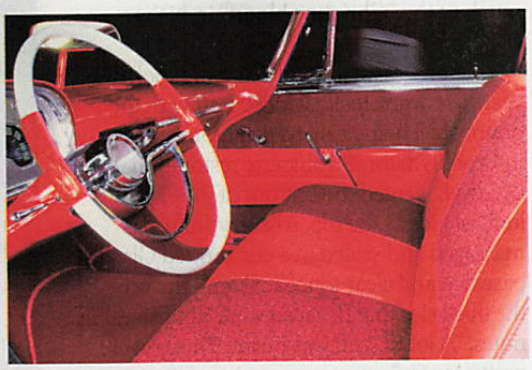


New Yorker Joe Caldwell owns this particular car. His fascination with cars and horror movies started when he was a young lad. At the ripe age of 12, he had to sneak into the local movie theater to see *Christine* when it was released. Because of the movie's R-rating, that was the only way he was going to see it. He recalls, "As a kid, I went in with the expectation of seeing a great horror movie, and not realizing that the Plymouth was going to be the star of the movie. That's when I fell in love with the car."

The first muscle car he bought was a 1967 Plymouth GTX Hemi survivor. That car stayed with him for two years until someone came along and offered him stupid money for it. In his mind, that pile of cash was his ticket to be able to purchase one of the movie cars. Unfortunately, reality set in when it became clear that, with only two actual movie cars accounted for, getting one fell into the unobtanium category. That prompted a switch to plan B, which meant that he would build a clone, and in 2011 he

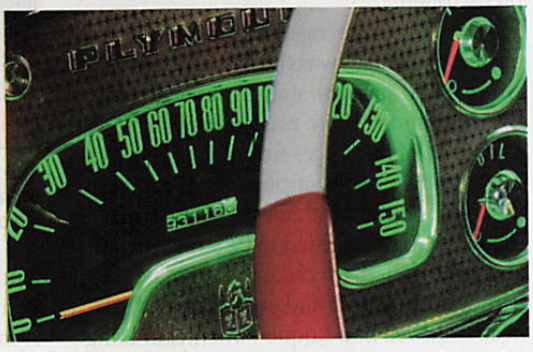
Detailed for movie accuracy, the 350 Golden Commando has been installed in the engine bay to represent the "show me" scene in the movie. While a faithful restoration would have valve covers and air cleaners painted in gold, on this car they are chrome plated.

Left: Zip ties were used in the movie to secure items like hoses, and that detail has been faithfully reproduced in this Fury.



Right: As with most '50s era cars, the interiors were colorful and used large amounts of chrome. Caldwell didn't have many donor parts to work with, so they were sourced from various places. The seats were upgraded to full leather when they were reupholstered.

Right: The instruments used in the restoration have the odometer running backward to mimic the reverse mileage that took place during the movie.



Left: Door-lock knobs were not available on '58 Plymouths; however they were needed in the choking scene in the movie, so they were added. The chrome that came with the donor doors included the original moldings that were drilled for them.

found his donor car in Arizona. It was a low mileage, rust free 1958 Savoy that had been stuck under a carport since 1974.

During the time leading up to this purchase, Joe had immersed himself into the world of *Christine* fandom, to the point that he became the co-president of one of the movie's fan clubs. It was through contacts with these clubs that his build went in a decidedly different direction, as one phone call from a friend got him closer to an actual movie car.

As you'd imagine, the remnants of the movie cars that ended up in the junkyard back in 1983 had been pretty well picked over, and the salvageable bodies had been sold. Fellow *Christine* fan Drew Picard had purchased and squirreled away a big stash of those parts. His plan was to build a car of his own from the parts he had amassed but, realizing that probably wasn't going to happen, Drew called Joe to ask if he was interested in the parts.

"I told him that I'd take them. I'll take it all. I didn't even ask how much," exclaimed Joe, who ended up buying numerous pallets of parts along with a rusty 1957 Savoy.

After all the parts were shipped to New York, his plans for the rust-free car shifted. He recounts, "I only ended up using the bare shell. That's it!" Everything else that was on that car was sold, along with any unusable parts that were obtained from Drew. The plan was to assemble his car using the bolt-on sheetmetal, drivetrain, and trim from the junked movie cars with the goal to have as

much of the "Christine blood" in his car as possible.

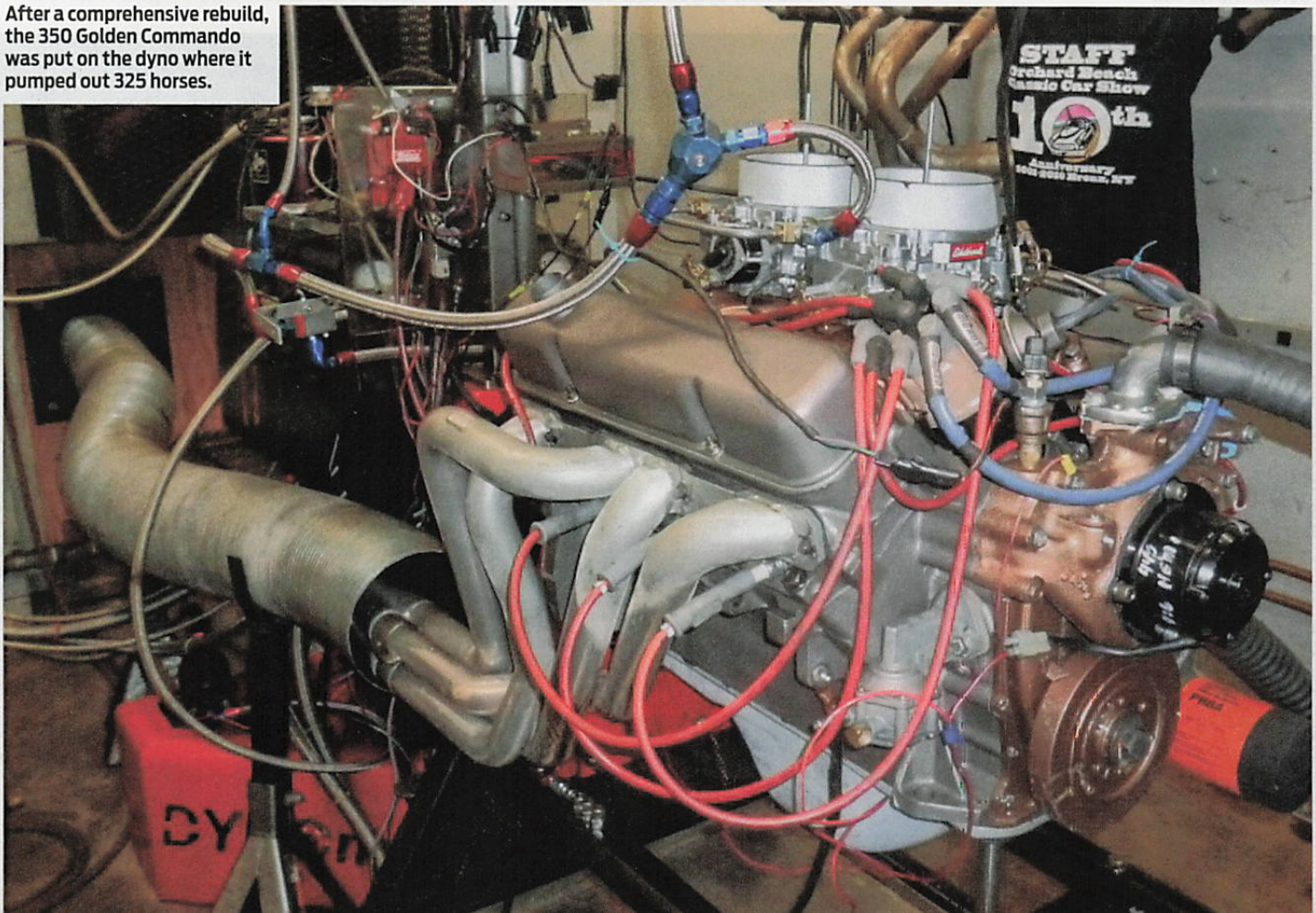
That process started in 2011 and took four years to complete. It all kicked off with the donor shell being sent to Brighton Collision in Brooklyn, for its rotisserie restoration. Caldwell wanted the bottom of the car to look as nice as the top, so everything was massaged and sealed in a custom red Glasurit basecoat and clear topcoat. Along the way, the obstacles that he faced were extensive. He notes, "A lot of stuff was burnt. Things were pretty rough."

As the car came together, one of the biggest challenges was the vast amount of chrome and stainless steel trim needed for the restoration. There was no easy fix for the poor state of the pieces from the movie cars. The bumpers, for example, were the ones that were on the car that was set on fire in the movie. They needed to be straightened and re-chromed. Much of the stainless trim was dinged up and even warped from heat. Caldwell had Roque Pimentel in Long Island, New York, handle the aluminum and stainless, while the chrome hardware was shipped to Librandi's Plating in Middletown, Pennsylvania. The money spent on these pieces alone was staggering. The interior and glass were additional hurdles that he needed to overcome. Many of the movie's stunt cars had no interior (the glass was painted black to hide that fact), so there weren't many useable parts in the mix. The front seat frames, dash, steering wheel, and a portion of the headliner were the only items used. Everything else was sourced from various places and sent to Carthom Upholstery in New Rochelle, New York. Vintage Glass USA in Tolland, Connecticut, crafted new side glass and a windshield for the Plymouth, while the rear window is an NOS piece that Caldwell purchased at the Carlisle Chrysler Nationals event. All that new glass was treated to a heavy layer of tint applied by Lorenzo Window Tinting in Bronx, New York. Carthom Upholstery finish the trunk in red leather, which included the installation of a 40-inch plasma TV that plays the movie at shows with help from a JL Audio sound system installed by Audio Etc in New Rochelle, New York.

The plan to use the Fury as a showpiece and incorporate the movie in its presentation has been enhanced with the finished trunk wrapped in leather. A 40-inch plasma TV and a JL Audio sound system also reside in the trunk.

When it came time to redo the drivetrain, he had a few donors to choose from. Included in the parts hoard were two engines, two rear axles, and two transmissions. After close inspection, the engine he went with was actually the one that the bulldozer drove over in the final scene of the movie. It was a dual-quad 350 Golden Commando that was complete, from intake to oil pan, and only needed a new set of carburetors and air cleaners. Like the body, the

After a comprehensive rebuild, the 350 Golden Commando was put on the dyno where it pumped out 325 horses.



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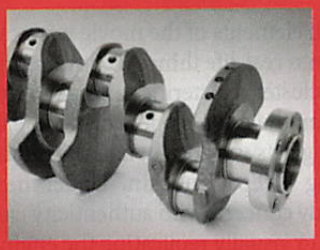

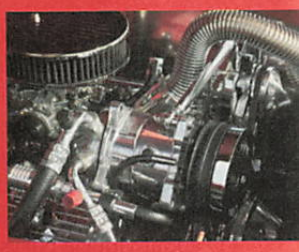

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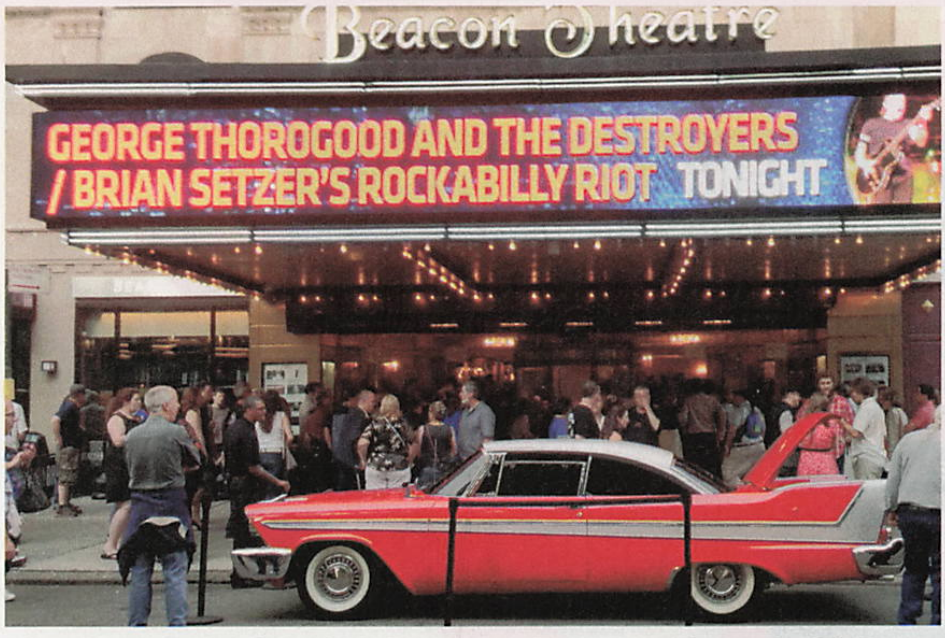
engine was treated to a comlete rebuild.

More than just a straight-up restoration, this car was a puzzle with many pieces merged from various sources. When it came time to put it all together he leaned heavily on his buddy "Fury" Jim Rawa. As the nickname implies, Jim knows a few things about vintage Furys and was instrumental in helping Caldwell reassemble the car. Because the vision was to emulate as much of the movie car's evil attributes as possible, certain elements of the movie were carried over into real-life things like the instrument cluster registering mileage in reverse; or when the door is opened, the interior lighting gets very bright and the radio starts playing "Keep a Knockin." Under the hood, the only concern with authenticity came down to visually replicating the engine that was filmed in the "show me" scene. There is chrome where paint should have been applied, but it is all legit, right down to the zip ties holding things in place.

Since that unveiling, Joe has traveled extensively with the car and can often be found at Mopar events, Terror Con, and Comic Con shows with some of the original cast from the movie. It also set him on a path to document, as much as possible, the history and background of the movie cars. He has an extensive archive of behind-the-scenes movie photos, a large amount of emails from everyone involved in the production of the film, and a copy of the salvage yard's ledger with the serial numbers of the junked cars.

This recreation is about as close as anyone will ever get to an actual Christine from the movie. For Joe Caldwell, it is the culmination of that 12-year-old boy's desire to one day own such a car. HR



Above: After the Fury was finished, it had its maiden outing at a George Thorogood and The Destroyers concert at the Beacon Theatre in New York City. His song, "Bad to the Bone" was used in the opening minutes of the movie. **Right:** Included in the huge amount of parts Joe purchased were a set of movie car quarter-panels. These were never used, as it didn't make sense to remove the solid ones on the donor car. These eventually went to a new home.

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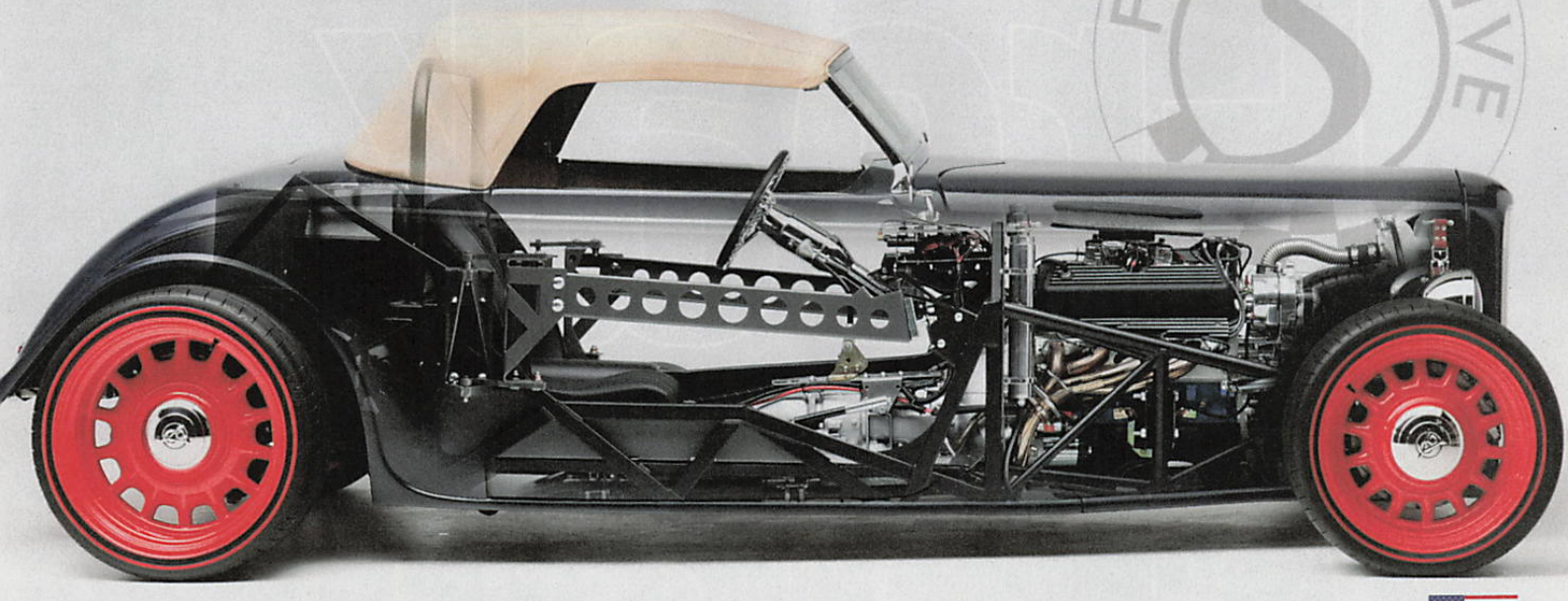

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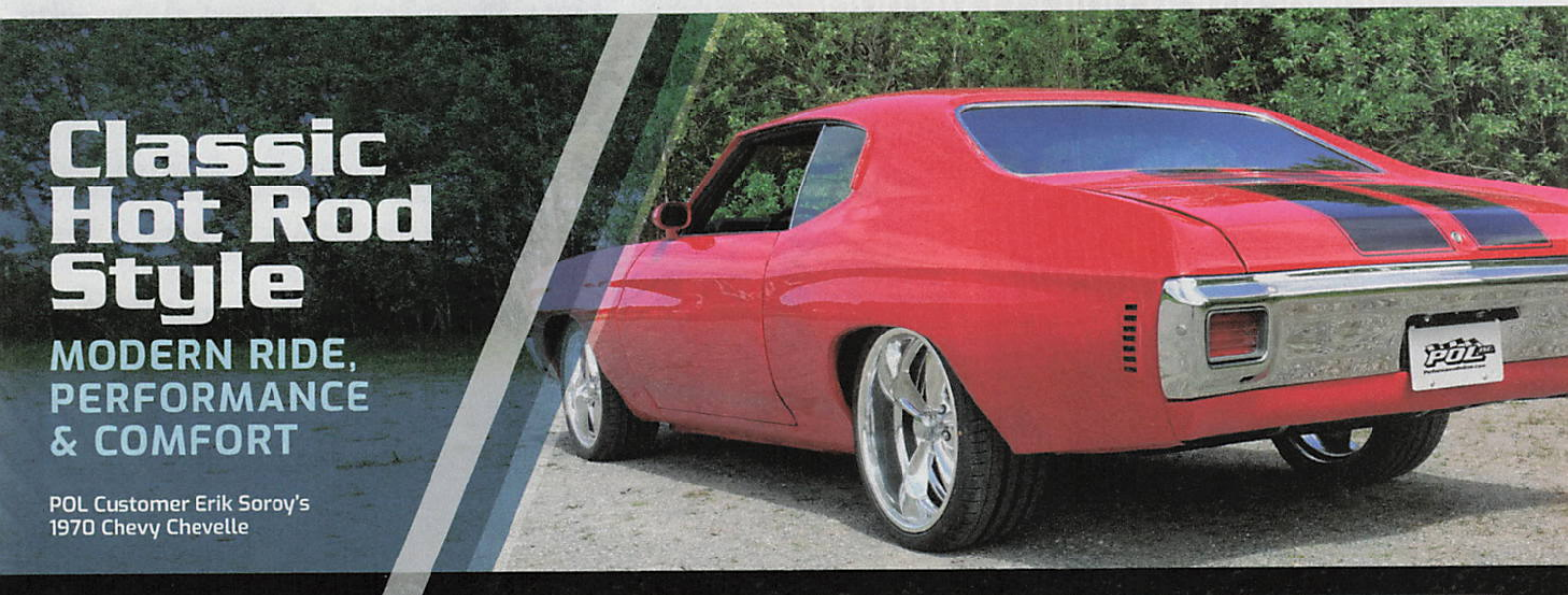

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Freak Alert!

3,424 HP SUPERCHARGED 24-CYLINDER PETERBILT SEMITRUCK

If you thought the Transformers were only in the movies, then you've never been to Lake Havasu City on the California-Arizona border. The Colorado River cuts through the desert tourist spot, but up on the north end of town, an airport hangar holds what looks like Optimus Prime's bigger and more bad-ass older brother: Thor24.

Dreamt up by Southern California land developer Mike Harrah, and built over a seven-year period by Mike with Tim Spinks and Paul Abram, the truck has so much going on it's hard to focus on just one facet. It's safe to say, however, each one is as equally impressive as the other, right down the line. Big Mike, as he's called, stands 6 feet, 5 inches and has a larger-than-life personality that is personified in this truck where even the smallest detail has been amplified to 11. Add all those hundreds of wild parts and immensely creative pieces together and you get, well, Thor.

Eric Geisert

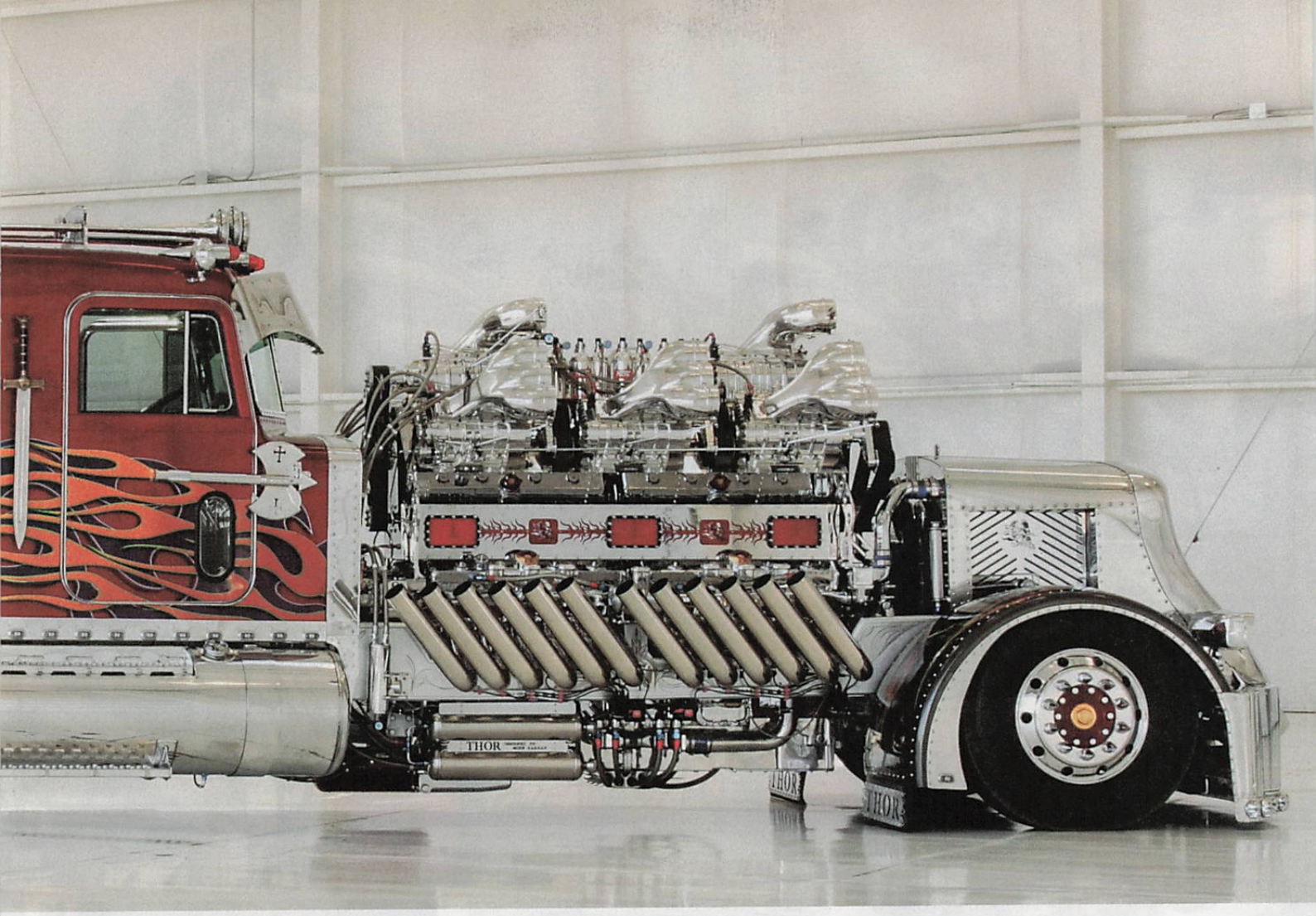
FREAK ALERT

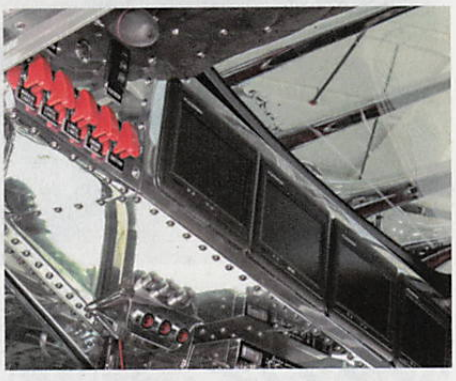
The engines are what you see first and command the majority of your attention. That's because no one has ever seen twin 12V-71 (24 cylinders total) two-stroke Detroit Diesel engines mated nose-to-nose and topped with eight BDS 8-71 superchargers. The Detroit Diesels have a long and important history in industrial uses as well as in naval vessels, and the 12V-71 comes "stock" with twin Roots-type blowers located between the cylinder banks (so Thor has a total of 12 blowers). The build team figured out how to butt the engines together with a splined shaft, giving the dual-engine layout a final displacement of 1,704 cubic inches (or 27,923.56cc's if that's your inclination).

After constructing a wooden buck to help work out the design of the massive intake manifold, it was eventually remade in thick aluminum plate and then configured to hold the eight superchargers, all driven off a single custom driveshaft that is 103 inches long and weighing some 263 pounds that runs longitudinally inside the manifold's air box and above the in-line engines. The top of the manifold is also the base for eight NOS nitrous bottles.

Exhaust exits through 24 zoomie-type headers, and Mike says that at 2,500 rpm the engines produce 3,424 hp. In the high-performance world of blowers and big engines that might not sound like a lot, but with this setup in this 44-foot-long, 30,000-pound truck, it looks amazing—and the sound is out of this world. The engine combo attaches to a chromed Allison HT740 transmission underneath the 1979 359 Peterbilt cab that runs out to locker-type rear axle which has been completely ground smooth, filled, and chromed. Honestly, nearly everything on this truck is either chromed or covered in a wild paint job.

A stock Peterbilt semitruck front suspension and steering wouldn't work in this





application (Mike wanted to be able to turn and steer it in a smaller radius), so they installed a VanHool A-arm type suspension system usually used in buses and coaches. The chassis is made up of twin 4x14-inch sections of rectangular tubing (3/8-inch thick) that are 40-feet long and uses Peterbilt Air Leaf suspension. It rolls on Alcoa aluminum wheels wrapped in 315/30R22.5 tires front and 11R24.5 rears.

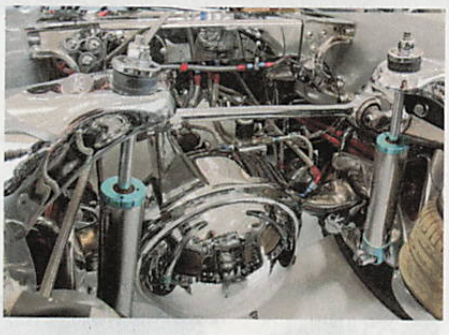
The cab, which is more of a command center for the truck's whole operation, is equally crowded with things to see, switches to throw, and gauges to watch. There are no less than 24 Autometer gauges in the polished aluminum panel (with Big Mike's profile engraved in the center) forward of the four-spoke Steering Creations steering wheel—among them a 200 mph speedo, a 6,000-rpm tach, and a handful of pressure and blower gauges, with six more blower

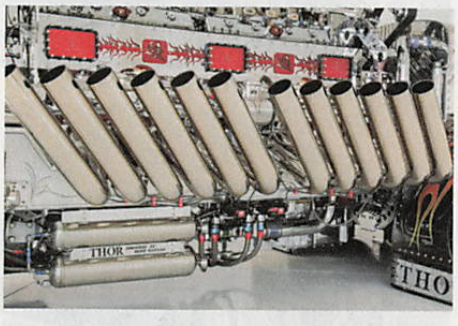
FREAK ALERT

pressure gauges mounted mid-dash.

Dual MOON footprint aluminum pedals are also used, and Lake Havasu's Main Stitch got the call to cover the interior with black diamond material for the headliner, dark gray industrial carpeting below, and black leather on the bucket seats as well as the bench seating in the back. Multi-point Simpson Platinum racing belts are outfitted for both driver and passenger. Big Mike loves his cigars, and a special pocket in the driver's door frame allows him to carry a box of his favorite Padron 1926 Series No.9 Natural stogies. Between the buckets is a sword (one of many found in and around the truck, along with dozens of chromed skulls), with this one being a dual-edge broadsword (think: Conan the Barbarian) that serves as the truck's gearshift lever.

The forward passenger door of the stretched and widened aluminum cab opens in a clockwise rotation motion off a pin mounted behind a broadaxe (you read that right) mounted on the cab's exterior. Another broadsword mounted between the front and rear doors is just for decoration. Looking forward around the rows of blowers is a bit of a trick, but in the cab and above the driver are four 4x6 video screens that are used to see





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The problem isn't getting it up above 100 mph, it's stopping it once you do!"

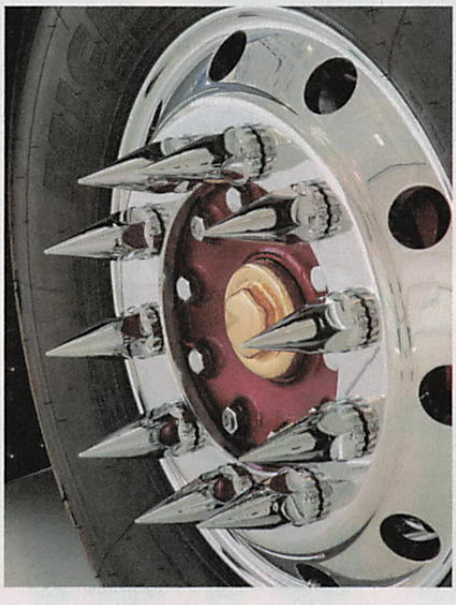
FREAK ALERT

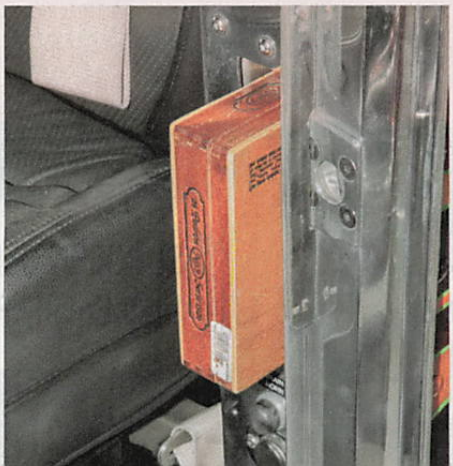
what's on the road ahead of Thor.

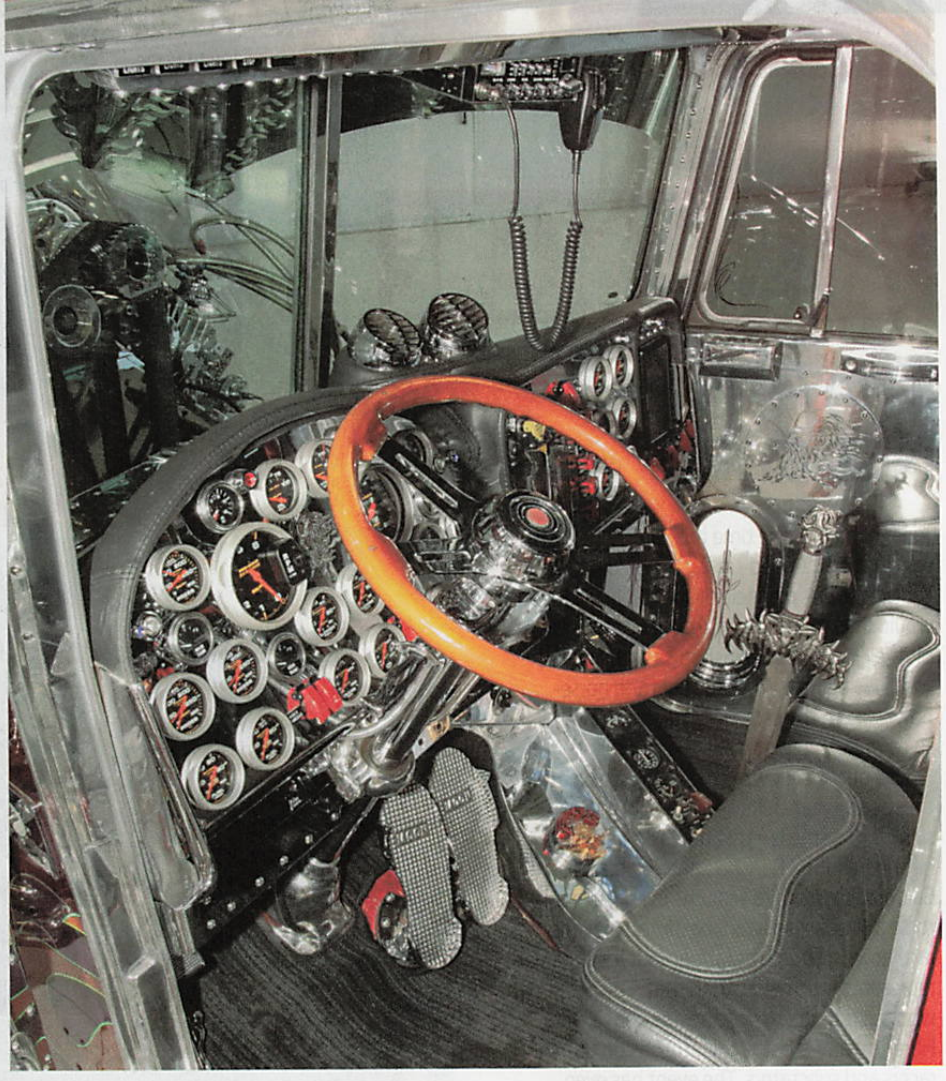
Entertainment is available in the "crew" section of the cab with a 40-inch TV screen for watching videos, or a 1,500-watt sound system mounted in a special exterior compartment that would have no problem providing the soundtrack to whatever you and 100 of your friends wanted to do in your garage. Mounted behind the cab is a Hawker Jet helicopter engine that is the auxiliary power generator for the truck (and it sounds awesome when lit).

Another custom addition is the massively oversized and stylized '33 Ford aluminum grille, fabricated in California by Marcel's Custom Metal. The whole semi was covered with PPG Envirobase waterborne Candy Red paint applied by Glenn Bohannon at Brothers Auto Body in Lake Havasu City. That was followed up with multi-colored flames and an amazing graphics scheme, that included murals, from SKC Customz; and old-school pinstriping by Havasu's Chris Snead.

Seeing this truck on the road must evoke the same feeling folks had when Howard Hughes flew his H-4 Hercules

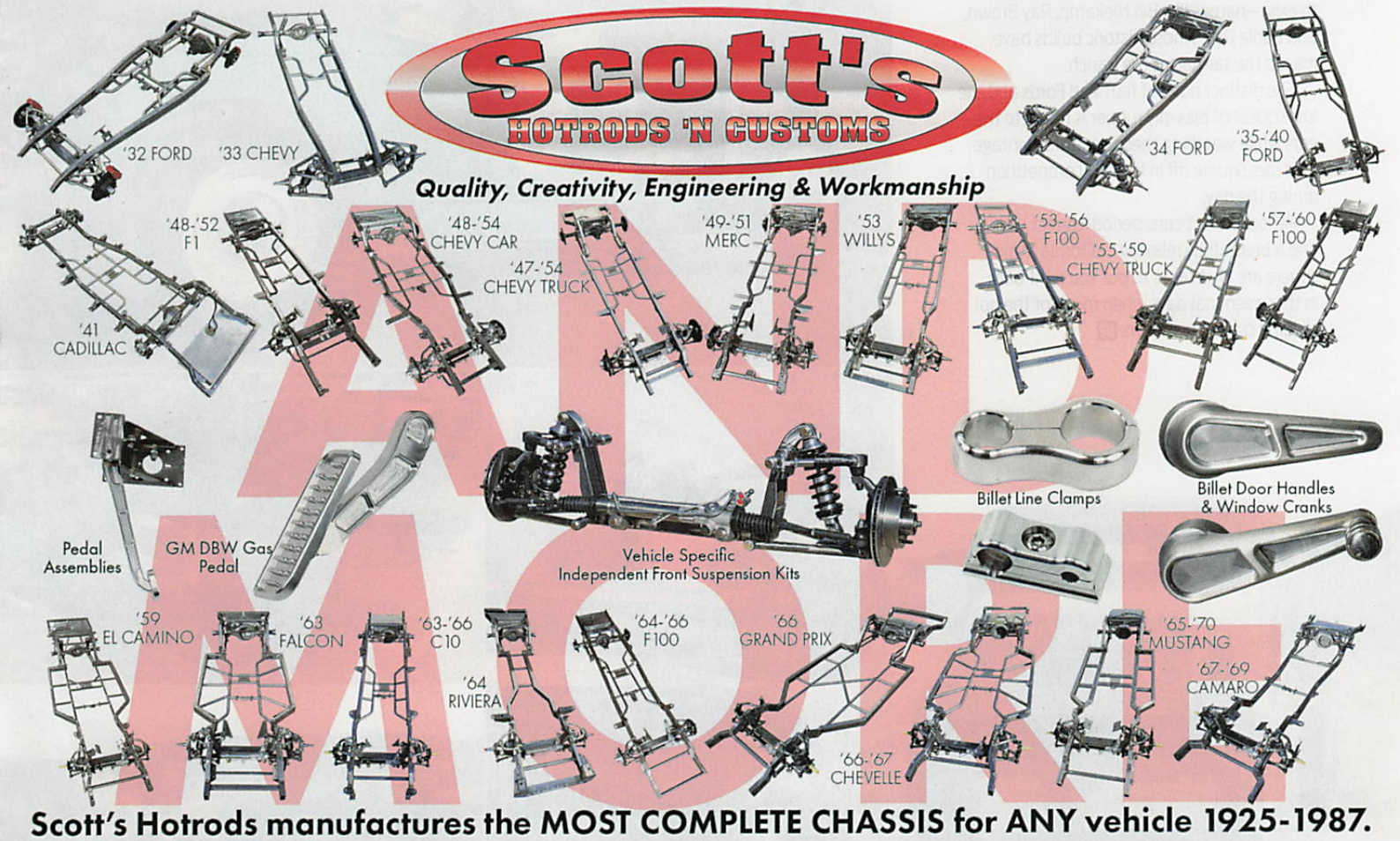






(aka Spruce Goose) in Southern California's Long Beach Harbor in 1947—it is so strange to see something so massive moving under its own power, bouncing a bit to the rhythm of the idling blowers and the 40-foot chassis gently torquing up and down as it rolls on by. But, as Mike says, "The problem isn't getting it up above 100 mph, it's stopping it once you do!" We imagine it would be like trying to stop a freight train, only without the railroad tracks. But, it does have four 12-foot Simpson drag parachutes packed across the rear bumper just in case!

And, as if this build isn't astonishing enough, tucked away in the hanger where Mike parks this beast is *another* similarly-sized, stretched semi going together! This one, already nicknamed Medusa, is a mid-engine (with another twin 12V-71 layout) drag racing version of Thor. To all those folks who said the original concept couldn't actually work or drive—we believe they've never spent any time with Mike Harrah. He definitely dreams really big, and we can't wait to see Thor and his new ride parked side by side someday.



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ON THE SCENE

The RPM Nationals

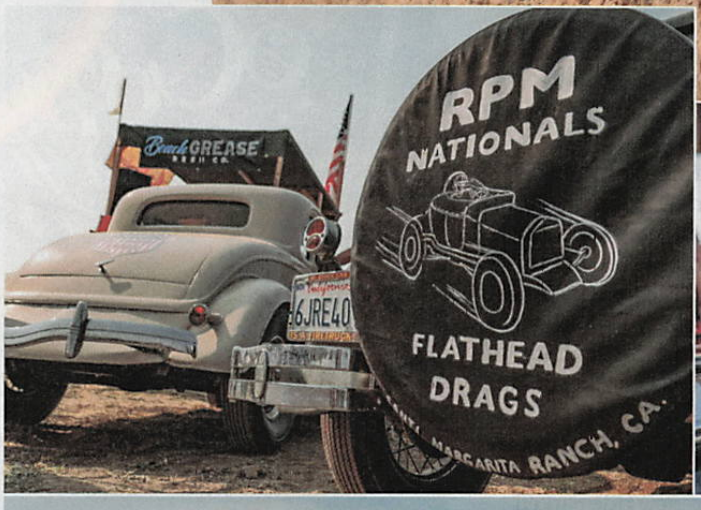
Povi Pullinen

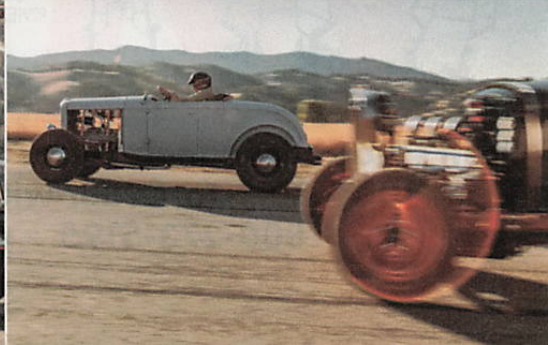
Right around the time this very magazine was formed, hopped-up flathead V8s were considered the pinnacle of speed. Hot rodders would take to the local streets and strips to pit their creations against one another to see who was fastest. While the cars and horsepower figures have changed dramatically since then, the spirit is still the same.

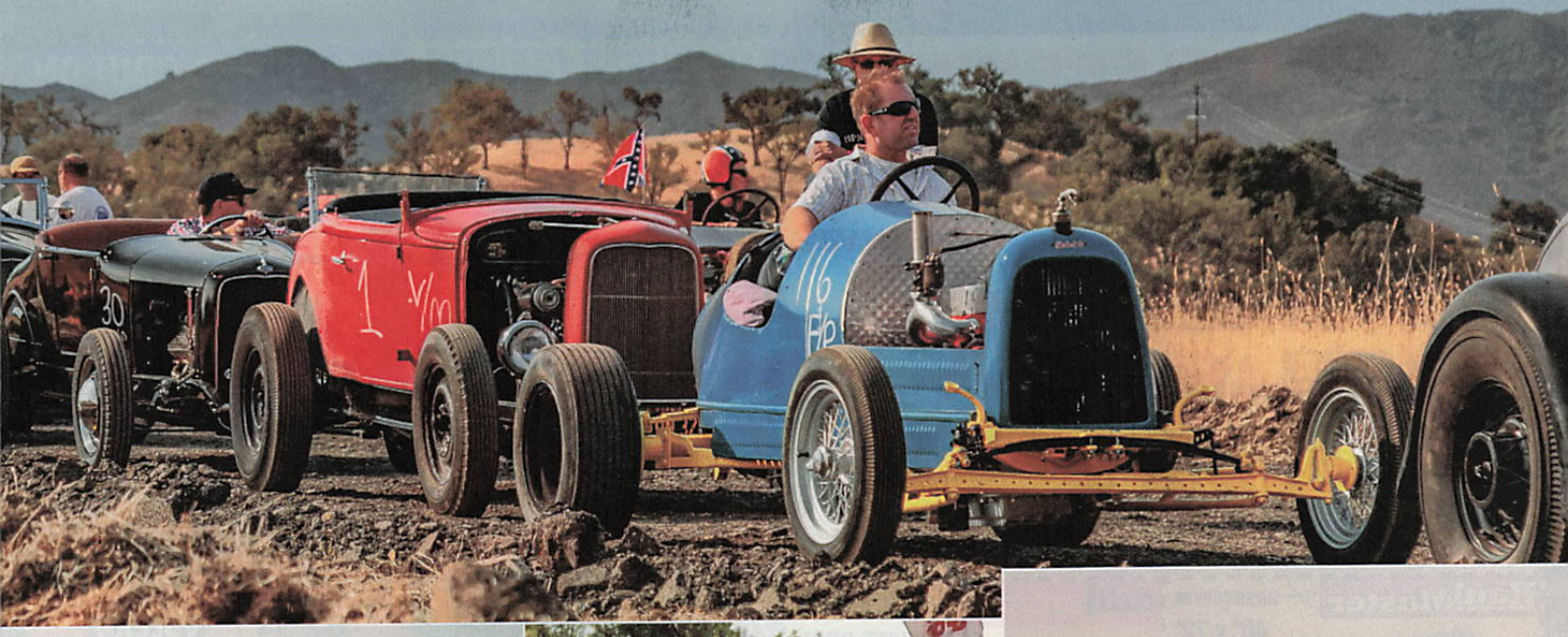
One of the best ways to experience what those early years felt like—the sights, the sounds, the smells—is at the RPM Nationals held in beautiful Rancho Santa Margarita, California. In its third year, the event seems to be a simple flag-start, no-time, two-lane race down a stretch of tarmac, but it actually represents much more than that. The people who put it together: Justin Baas and Russ Hare, live and breathe this stuff, as do the racers and spectators. The event has even attracted some of the most iconic hot rods to exist—names like Bill Niekamp, Ray Brown, and Eddie Dye, whose historic builds have graced the tarmac at the Ranch.

The distinct howl of flathead Fords and the low squeal of bias-ply rubber is music to the ears while watching these beautiful, vintage race cars square off in friendly competition during the day.

Period-correct cars, period-correct racing, and a beautifully relaxing California atmosphere are all it takes to put you right back in those seminal days when much of the hot rodding culture was born. HR



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1 V/100
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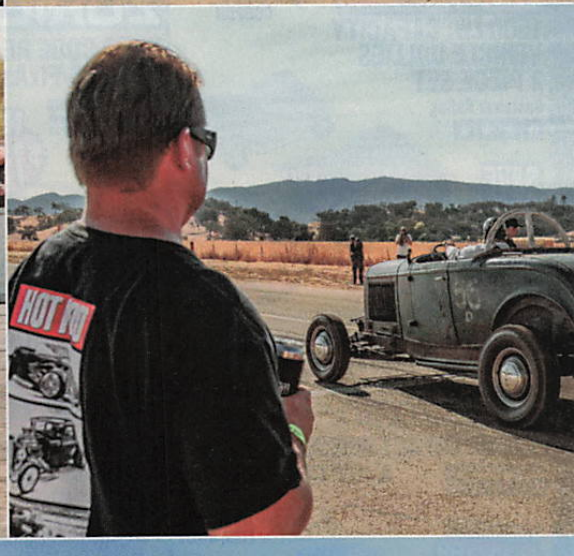
F/P

305

VR 139

3 V/R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COMPARE TO TEQ CORRECT $189.99 MODEL: T83001BZ

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- 3 - AAA Batteries (included)
- 144 Lumens

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COMPARE TO PERFORMANCE TOOL $13.52 MODEL: W2364

ITEM 63878/63991 64005/60566 63601/67227 shown

55675020

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55676972

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HaulMaster — SUPER COUPON

40" x 72" MOVING BLANKET

Customer Rating ★★★★★

SAVE 60%

COMPARE TO PRATT RETAIL SPECIALTIES $9.98 MODEL: HDMOVBLAN

~~$4.99~~ NOW $3.99

ITEM 69504/62336/47262 shown

55679646

LIMIT 4 - Coupon valid through 4/7/20*

drill master — SUPER COUPON

1500 WATT DUAL TEMPERATURE HEAT GUN (572°/1112°)

Customer Rating ★★★★★

NOW $9.99

COMPARE TO BLACK+DECKER $28.06 MODEL: HG1300

SAVE 64%

~~$14.99~~

ITEM 63104/35776/62340/62546/96289 shown

55681393

LIMIT 5 - Coupon valid through 4/7/20*

SUPER COUPON

TITANIUM BETTER Professional Performance | BEST Industrial Performance VULCAN

UNLIMITED 200™ PROFESSIONAL MULTIPROCESS WELDER

NOW $649.99 ~~$699.99~~

Customer Rating ★★★★★

COMPARE TO ESAB $902.60 MODEL: W1003141

SAVE $252

ITEM 64806

55682305

LIMIT 1 - Coupon valid through 4/7/20*

OMNIPRO™ 220 INDUSTRIALMULTIPROCESS WELDER

NOW $869.99 ~~$939.99~~

COMPARE TO LINCOLN ELECTRIC $1,432 MODEL: K3963-1

Customer Rating ★★★★★

SAVE $562

ITEM 63621

55685935

LIMIT 1 - Coupon valid through 4/7/20*

PITTSBURGH AUTOMOTIVE — SUPER COUPON

1500 LB. CAPACITY VEHICLE DOLLIES 2 PIECE SET

Customer Rating ★★★★★

SAVE 55%

COMPARE TO ROUGHNECK $89.99 MODEL: 27918

NOW $39.99 ~~$56.99~~

ITEM 60343/67338 shown

55686153

LIMIT 2 - Coupon valid through 4/7/20*

ZURICH — SUPER COUPON

OBD2 CODE READER WITH ABS/SRS/FixAssist® ZR13

Customer Rating ★★★★★

NOW $159.99 ~~$189.99~~

SAVE $178

COMPARE TO Snap-on BLUE-POINT $338 MODEL: EECR3A

ITEM 63806

55690115

LIMIT 1 - Coupon valid through 4/7/20*

WARRIOR — SUPER COUPON

3 PIECE TITANIUM STEP BIT SET

Customer Rating ★★★★★

- 28 unique hole sizes

SAVE 85%

NOW $8.99 ~~$13.99~~

COMPARE TO IRWIN $59.98 MODEL: 15504PKSM

ITEM 69087/60379/91616 shown

55692287

LIMIT 4 - Coupon valid through 4/7/20*

CHICAGO ELECTRIC WELDING — SUPER COUPON

STANDARD AUTO-DARKENING WELDING HELMET

NOW $34.99 ~~$44.99~~

SAVE 56%

Customer Rating ★★★★★

COMPARE TO KOBALT $79.99 MODEL: SGY-A13

ITEM 61611 56358/46092 shown

57461640

LIMIT 2 - Coupon valid through 4/7/20*

EARTHQUAKE XT — SUPER COUPON

PRO AIR IMPACT WRENCHES

Customer Rating ★★★★★

A. 1/2" COMPOSITE PRO ITEM 62891 ~~$149.99~~

B. WITH 2" ANVIL ITEM 63800

YOUR CHOICE $129.99

1190 FT. LBS. TORQUE BOLT BREAKAWAY

SAVE $484 COMPARE TO SNAP-ON $614.95 MODEL: PT850

57477808

LIMIT 1 - Coupon valid through 4/7/20*

MADDOX — SUPER COUPON

BALL JOINT SERVICE KIT FOR 2WD AND 4WD VEHICLES

Customer Rating ★★★★★

~~$89.99~~ NOW $59.99

COMPARE TO POWERBUILT $158.99 MODEL: 940579

SAVE $99

ITEM 63610/63279/64399/63258 shown

57481353

LIMIT 2 - Coupon valid through 4/7/20*

CEN-TECH — SUPER COUPON

AUTOMATIC BATTERY FLOAT CHARGER

Customer Rating ★★★★★

NOW $4.99 ~~$9.99~~

COMPARE TO SCHUMACHER ELECTRIC $30.41 MODEL: SC1

SAVE 83%

ITEM 69594/69955/64284/42292 shown

57485969

LIMIT 4 - Coupon valid through 4/7/20*

CHICAGO ELECTRIC WELDING — SUPER COUPON

WELDING STORAGE CABINET

Customer Rating ★★★★★ Welders, tools & supplies sold separately.

SAVE $90 NOW $149.99

COMPARE TO KLUTCH $239.99 MODEL: 48348

~~$169.99~~

ITEM 62275/61705 shown

57515755

LIMIT 1 - Coupon valid through 4/7/20*

CENTRAL PNEUMATIC — SUPER COUPON

3 GALLON, 100 PSI OIL-FREE AIR COMPRESSORS

- Air delivery: 0.6 CFM @ 90 PSI

~~$59.99~~

HOT DOG ITEM 69269 97080 shown

PANCAKE ITEM 61615/60637 95275 shown

YOUR CHOICE $39.99

Customer Rating ★★★★★

COMPARE TO PORTER-CABLE $98.62 MODEL: PCFP02003

SAVE 59%

57525453

LIMIT 2 - Coupon valid through 4/7/20*

PITTSBURGH AUTOMOTIVE — SUPER COUPON

5 PIECE TRIM AND MOLDING TOOL SET

Customer Rating ★★★★★

NOW $5.99 ~~$9.50~~

COMPARE TO OEM $17.99 MODEL: 25314

SAVE 66%

ITEM 64126/67021 shown

57526419

LIMIT 4 - Coupon valid through 4/7/20*

FRANKLIN — SUPER COUPON

OSHA/ANSI COMPLIANT

17 FT. TYPE IA MULTI-TASK LADDER

- Versatile - 24 configurations
- Safe + Secure + Stable
- Super Strong - Holds 300 lbs.
- Weighs 34 lbs.

~~$139.99~~ NOW $109.99

COMPARE TO LITTLE GIANT $298.99 MODEL: XE M17

SAVE $189

Customer Rating ★★★★★

ITEM 63419/67646/62514/63418/63417 shown

57527240

LIMIT 1 - Coupon valid through 4/7/20*

PITTSBURGH — SUPER COUPON

9 PIECE, 1/4", 3/8" AND 1/2" DRIVE WOBBLE SOCKET EXTENSION SET

LIFETIME WARRANTY

Customer Rating ★★★★★

SAVE 56%

NOW $9.99

COMPARE TO KLUTCH $22.99 MODEL: 40033

~~$14.99~~

ITEM 61278/67971 shown

57528635

LIMIT 4 - Coupon valid through 4/7/20*

PITTSBURGH SUPER COUPON

225 PIECE MECHANIC'S TOOL KIT

LIFETIME WARRANTY

NOW $99.99

$139.99

COMPARE TO KLUTCH $274.99 MODEL: 48101

Customer Rating

SAVE $175

SAE AND METRIC

ITEM 64367/62664 shown

57529184

LIMIT 2 - Coupon valid through 4/7/20*

SUPER COUPON

Customer Rating

10" PNEUMATIC TIRE

NOW $3.99

$5.99

SAVE 50%

COMPARE TO FARM & RANCH $8.09 MODEL: FR1055

ITEM 69385/62388/62409/62698/30900 shown

57530634

LIMIT 4 - Coupon valid through 4/7/20*

U.S. GENERAL BIGGER • STRONGER • MORE STABLE SERIES 2 SUPER COUPON

Customer Rating

26" x 22" SINGLE BANK EXTRA DEEP CABINETS

$299.99

YOUR CHOICE OF 6 COLORS $279.99

SAVE $1,470

- 9800 cu. in. of storage
- 1000 lb. capacity
- Weighs 175 lbs.

COMPARE TO SNAP-ON $1,750 MODEL: KRA4008FPBO

57535067

LIMIT 1 - Coupon valid through 4/7/20*

Item 64434, 64432, 64162, 56104, 56105, 56106

Haul Master SUPER COUPON

3/8" x 14 FT., GRADE 43 TOWING CHAIN

Customer Rating

- 5400 lb. capacity

NOW $19.99

$39.99

COMPARE TO MIBRO $64.99 MODEL: 426920

SAVE 69%

ITEM 40462/60658/97711 shown

57536524

LIMIT 4 - Coupon valid through 4/7/20*

PREDATOR SUPER COUPON

Customer Rating

3500 WATT SUPER QUIET INVERTER GENERATOR

- 11 hour run time

NOW $699.99

$799.99

COMPARE TO HONDA $2,019 MODEL: EU3000iS1A

SAVE $1,319

ITEM 56720/63584 shown

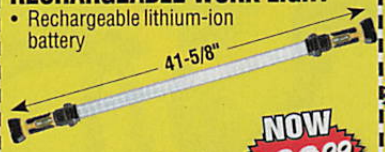
57537680

LIMIT 1 - Coupon valid through 4/7/20*

BRAUN SUPER COUPON

845 LUMEN UNDERHOOD RECHARGEABLE WORK LIGHT

- Rechargeable lithium-ion battery



NOW $29.99

Customer Rating $34.99

COMPARE TO BAYCO $109.12 MODEL: SLR-2120

ITEM 63990

SAVE $79

57538296

LIMIT 2 - Coupon valid through 4/7/20*

CENTRAL MACHINERY SUPER COUPON

10", 12 SPEED BENCHTOP DRILL PRESS

NOW $99.99

Customer Rating

$139.99

SAVE $61

COMPARE TO WEN $161.97 MODEL: 4212

ITEM 63471/44836/60237 shown

57544808

LIMIT 1 - Coupon valid through 4/7/20*

CHICAGO ELECTRIC POWER TOOLS SUPER COUPON

10", 15 AMP BENCHTOP TABLE SAW

Customer Rating

NOW $114.99

Stand sold separately.

$144.99

COMPARE TO RYOBI $229 MODEL: RTS22

SAVE $114

ITEM 45804/63117/64459/63118 shown

57552003

LIMIT 1 - Coupon valid through 4/7/20*

HARDY SUPER COUPON

Customer Rating

POWDER-FREE NITRILE GLOVES PACK OF 100

- 5 mil thickness

12¢ PER PAIR

SAVE 59%

NOW $5.99

$7.99

COMPARE TO VENOM $14.97 MODEL: VEN4145

ITEM 37050, 64417, 64418, 61363, 68497, 61360, 61359, 68498, 68496 shown

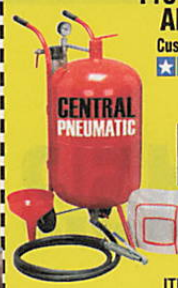
57553728

LIMIT 5 - Coupon valid through 4/7/20*

CENTRALPNEUMATIC SUPER COUPON

110 LB. PRESSURIZED ABRASIVE BLASTER

Customer Rating



NOW $109.99

SAVE $170

$139.99

COMPARE TO ATD TOOLS $279.99 MODEL: 8402

ITEM 69724/38375/60696 shown

57554456

LIMIT 1 - Coupon valid through 4/7/20*

CHICAGO ELECTRIC POWER TOOLS SUPER COUPON

6 AMP VARIABLE SPEED RECIPROCATING SAW

Customer Rating

Blade sold separately.

NOW $19.99

COMPARE TO PORTER-CABLE $59.98 MODEL: PCE360

SAVE 66%

$29.99

ITEM 65570/61884/62370 shown

57554852

LIMIT 4 - Coupon valid through 4/7/20*

Kenway SUPER COUPON

12 VOLT LED MAGNETIC TOWING LIGHT KIT

Customer Rating

NOW $19.99

$37.99

COMPARE TO BLAZER $42.65 MODEL: C7300

ITEM 64282

SAVE 53%

57555333

LIMIT 4 - Coupon valid through 4/7/20*

CENTRAL MACHINERY SUPER COUPON

20 TON SHOP PRESS

Customer Rating

NOW $149.99

$189.99

- Extreme heavy duty steel construction

COMPARE TO STRONGWAY $379.99 MODEL: 46260

SAVE $230

ITEM 32879/60603 shown

57557291

LIMIT 1 - Coupon valid through 4/7/20*

Haul Master SUPER COUPON

4 PIECE, 1" x 15 FT. RATCHETING TIE DOWNS

Customer Rating

- 400 lb. working load

SAVE 69%

NOW $6.99

$12.99

COMPARE TO KEEPER $22.80 MODEL: 5505

ITEM 90984/61524/63056 63057/63150/56668/63094 shown

57557884

LIMIT 4 - Coupon valid through 4/7/20*

PREDATOR SUPER COUPON

6.5 HP (212 CC) OHV HORIZONTAL SHAFT GAS ENGINE

NOW $99.99

$119.99

Customer Rating

COMPARE TO HONDA $329.99 MODEL: GX200UT2QX2

SAVE $230

ITEM 60363/69730 shown

ITEM 68121/69727 CALIFORNIA ONLY

57557920

LIMIT 1 - Coupon valid through 4/7/20*

Bauer SUPER COUPON

Customer Rating

5" DEEP CUT VARIABLE SPEED BAND SAW

NOW $99.99

$134.99

Blade sold separately.

COMPARE TO DEWALT $269.96 MODEL: DWM120

SAVE $169

ITEM 64194 63763 63444 shown

57558032

LIMIT 2 - Coupon valid through 4/7/20*

CENTRALPNEUMATIC SUPER COUPON

Customer Rating

1/4" AIR ANGLE DIE GRINDER

NOW $9.99

$12.99

COMPARE TO HUSKY $49.98 MODEL: H4230C

SAVE 80%

ITEM 62439/32046 shown

57558471

LIMIT 4 - Coupon valid through 4/7/20*

Diablo SUPER COUPON

3/8" x 50 FT. INDUSTRIAL GRADE RUBBER AIR HOSE

Customer Rating

NOW $18.99

$24.99

COMPARE TO GOODYEAR $29.82 MODEL: 12865

SAVE 36%

ITEM 61939 62884/62890 shown

57558553

LIMIT 3 - Coupon valid through 4/7/20*

PITTSBURGH AUTOMOTIVE SUPER COUPON

LOW-PROFILE CREEPER

- 300 lb. capacity

Customer Rating

NOW $19.99

COMPARE TO POWER TORQUE $44.99 MODEL: GM40300

SAVE 55%

$29.99

ITEM 63371/63424/64169/63372 shown

57558653

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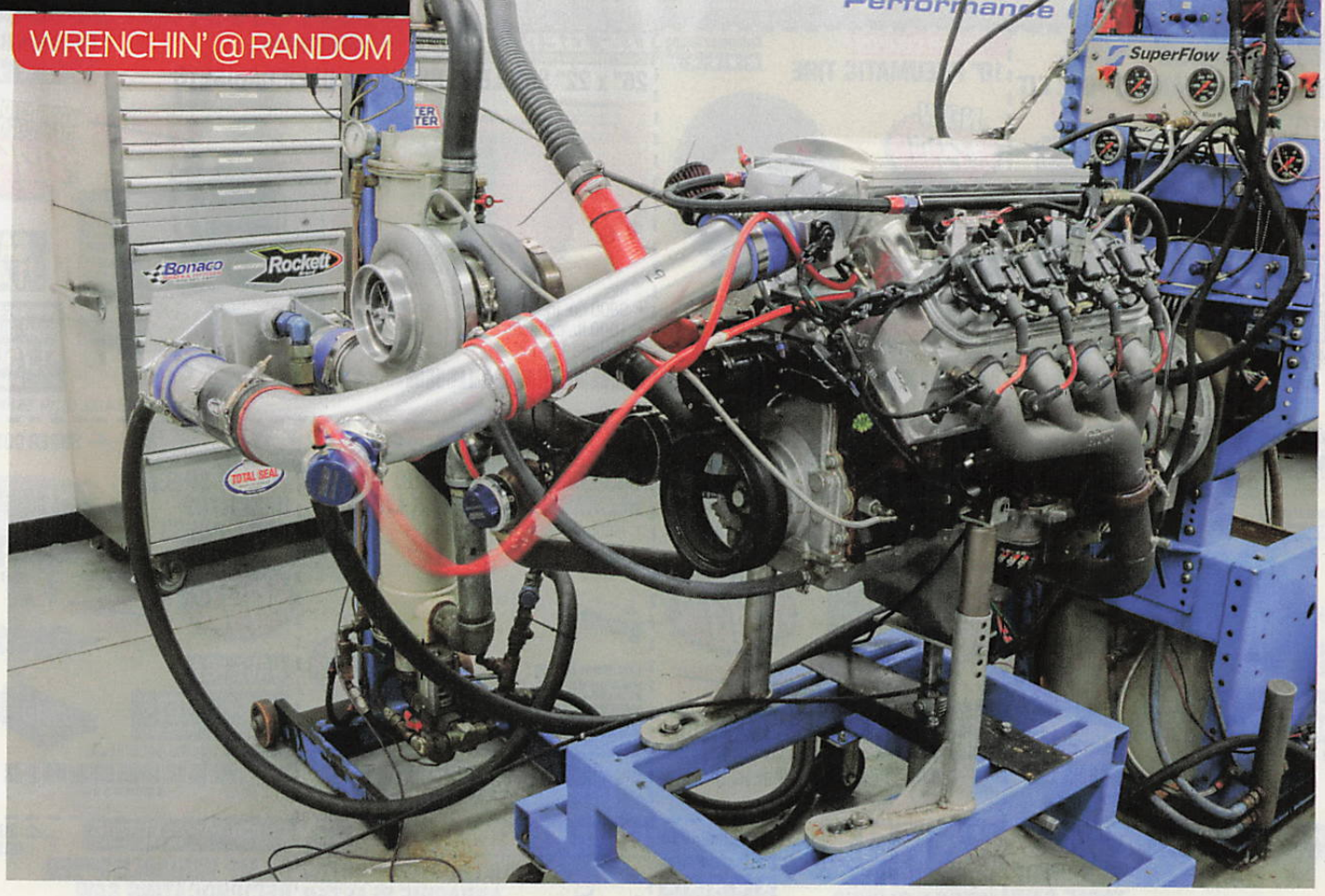


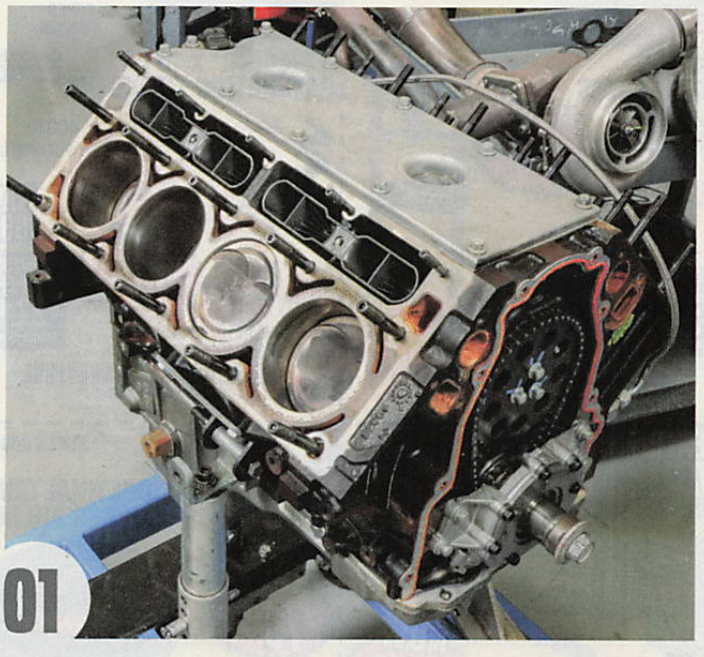
Make 800 HP With a Boosted 5.3

Richard Holdener

We all know how well the LS engine family responds to bolt-ons. We also know how well they respond to boost, so the obvious question, then, is how well do they respond to both? While the answer may seem obvious, there is much more to it. Suppose you upgrade your LS engine with a performance camshaft, aftermarket cylinder heads, or an intake manifold—or better yet: all three, like we did to our test engine. Will the power gains offered on the normally aspirated engine carry over once you add boost? What if the camshaft is tailored more toward forced induction, or not? The same could be asked of the intake or cylinder heads. We didn't know the answers to these questions going into this project, but we sure knew how to find out.

While the questions were simple enough, finding the answers required no less than four different engine configurations. The test would start with a stock (actually near stock) 5.3L which we ran first in naturally aspirated trim, then again with a single turbo system. After running those two configurations, we then replaced the stock cylinder heads, camshaft, and intake manifold with aftermarket versions, then ran the tests again—both naturally aspirated and with the same turbo system used on the stock engine. In doing so, we could compare the power gains offered on both the naturally-aspirated combo and on the turbocharged version.

To start, we used a 5.3L engine built by David Freiburger for an episode of *Engine Masters* on MotorTrend. Equipped with forged rods and pistons from Wiseco, we reconfigured it with a stock LM7 cam, the original 862 heads, and an early 5.3L truck intake and stock throttle body, a set of 120-pound Holley injectors and 1 7/8-inch long-tube Hooker headers. Dialing in the air/fuel ratio and timing curve was a Holley HP management system. Run in anger with the stock heads, cam, and intake, the 5.3L produced 333 hp at 5,200 rpm and 359 lb-ft of torque at 4,400 rpm. Now it was time for some boost!



01 This 5.3L was stuffed with a cast crank and forged Wiseco rods and pistons. Note the use of ARP head studs on the destined-for-boost build.

Sources

Brian Tooley Racing
888.959.8865; BrianTooleyRacing.com

Holley Performance Products
866.464.6553; Holley.com

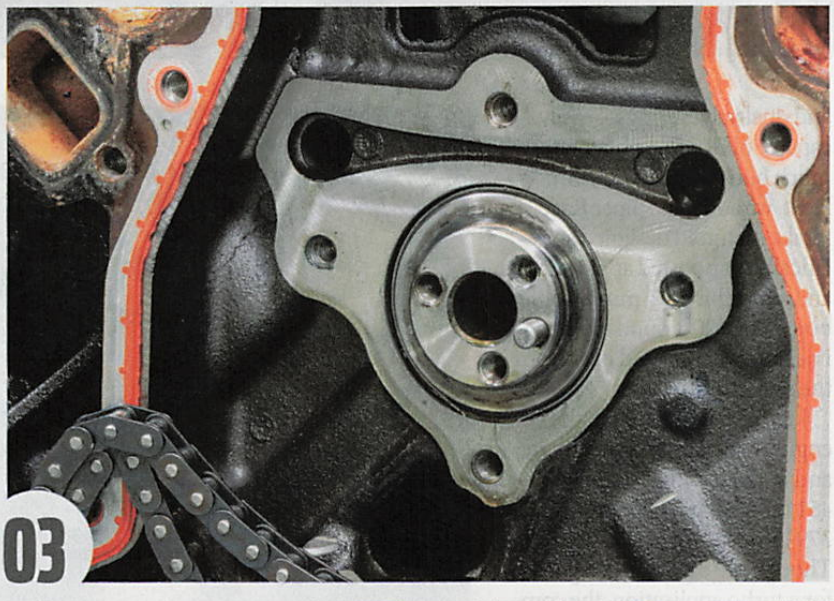
ProCharger Superchargers; 913.338.2886
ProCharger.com

Trick Flow Specialties;
888.841.6556; TrickFlow.com

Turbo Smart
909.476.2570; TurbosmartUSA.com

Wiseco
800.321.1364; Wiseco.com

02



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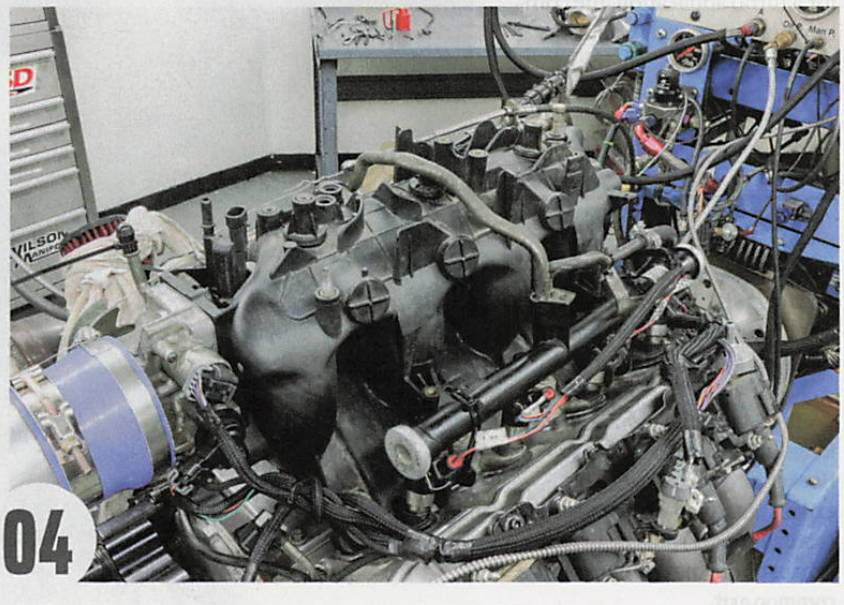


04

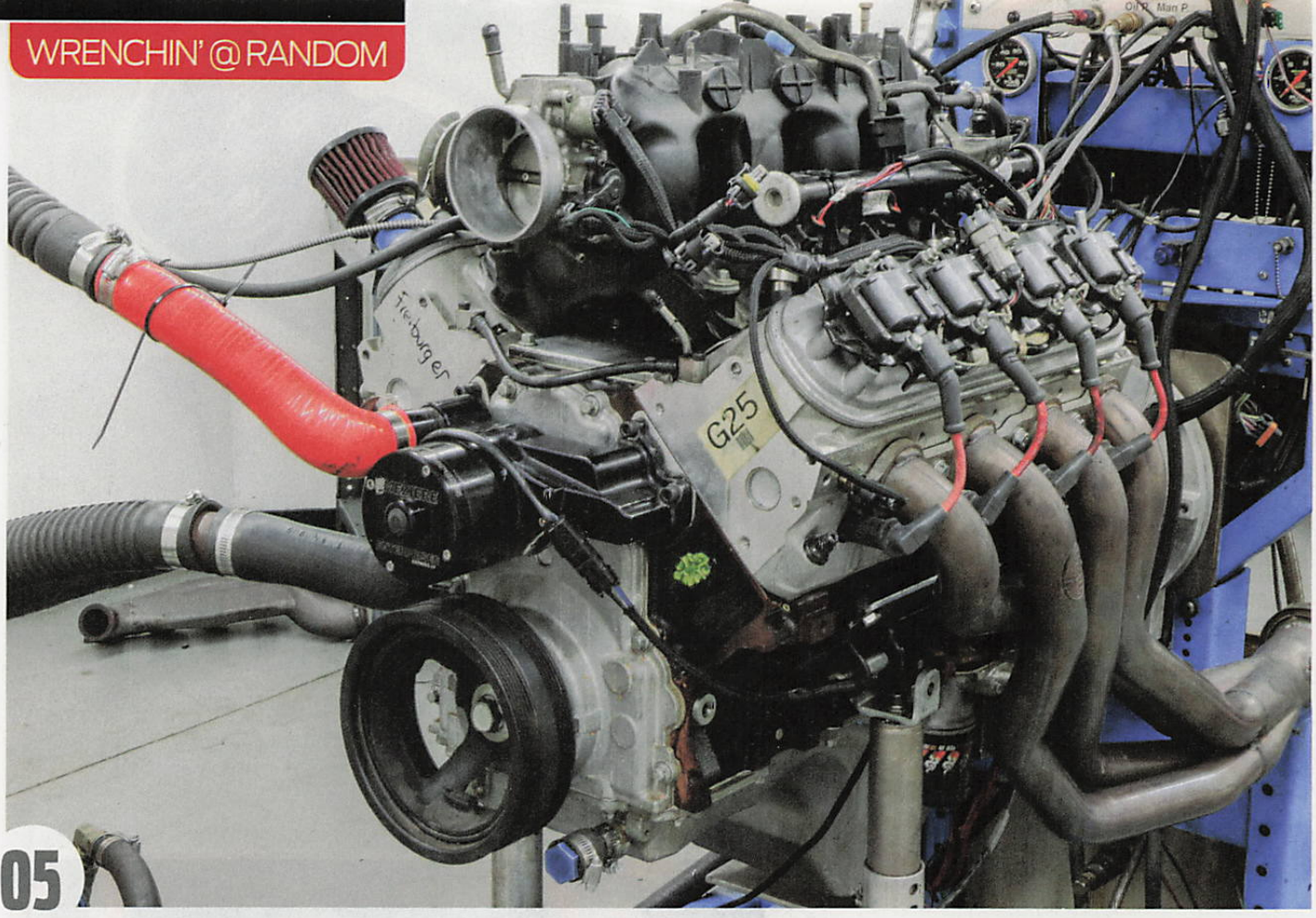
To provide the required positive pressure, we assembled a custom turbo kit that consisted of Holley's cast-iron turbo manifolds, a single S475 Borg Warner turbo from LJMS, and a Turbosmart Wastegate. Keeping things cool was an air-to-water intercooler from Procharger that we fed with the 90-degree dyno water. We ran the turbo system with a 10-pound wastegate spring and were rewarded with 532 hp at 5,500 rpm and 555 lb-ft of torque at 4,700 rpm. All of this came at a peak boost reading of 9.6 psi. Now, let's bolt in some performance parts!

Off came the stock intake and heads, and out came the stock cam. In their place went a Stage 2 Turbo cam from Brian Tooley Racing. It offers 226/231 degrees of duration, 0.605/0.598-inch lift, and a 113 +4 LSA. We matched this cam with a pair of Trick Flow Specialties GenX 205 heads. They were sized perfectly for the small (3.78-inch) bore used on the 5.3L, yet offered some big flow—enough to support 600 hp on the right naturally-aspirated combination. These heads are fully CNC-machined and come with 2.00-inch /1.575-inch stainless valves

02 Topping the 5.3L was a set of production 862 heads. The only modification made to the heads was a valvespring upgrade. The factory rockers were used on both the stock and modified versions.

03 We used a stock LM7 cam for our baseline test. Its specs are 190/191 degrees duration, 0.466/0.457-inch lift, and a 116-degree lobe separation angle.

04 Completing the package was the early 5.3L truck intake that was combined with a stock throttle body and fuel rail.

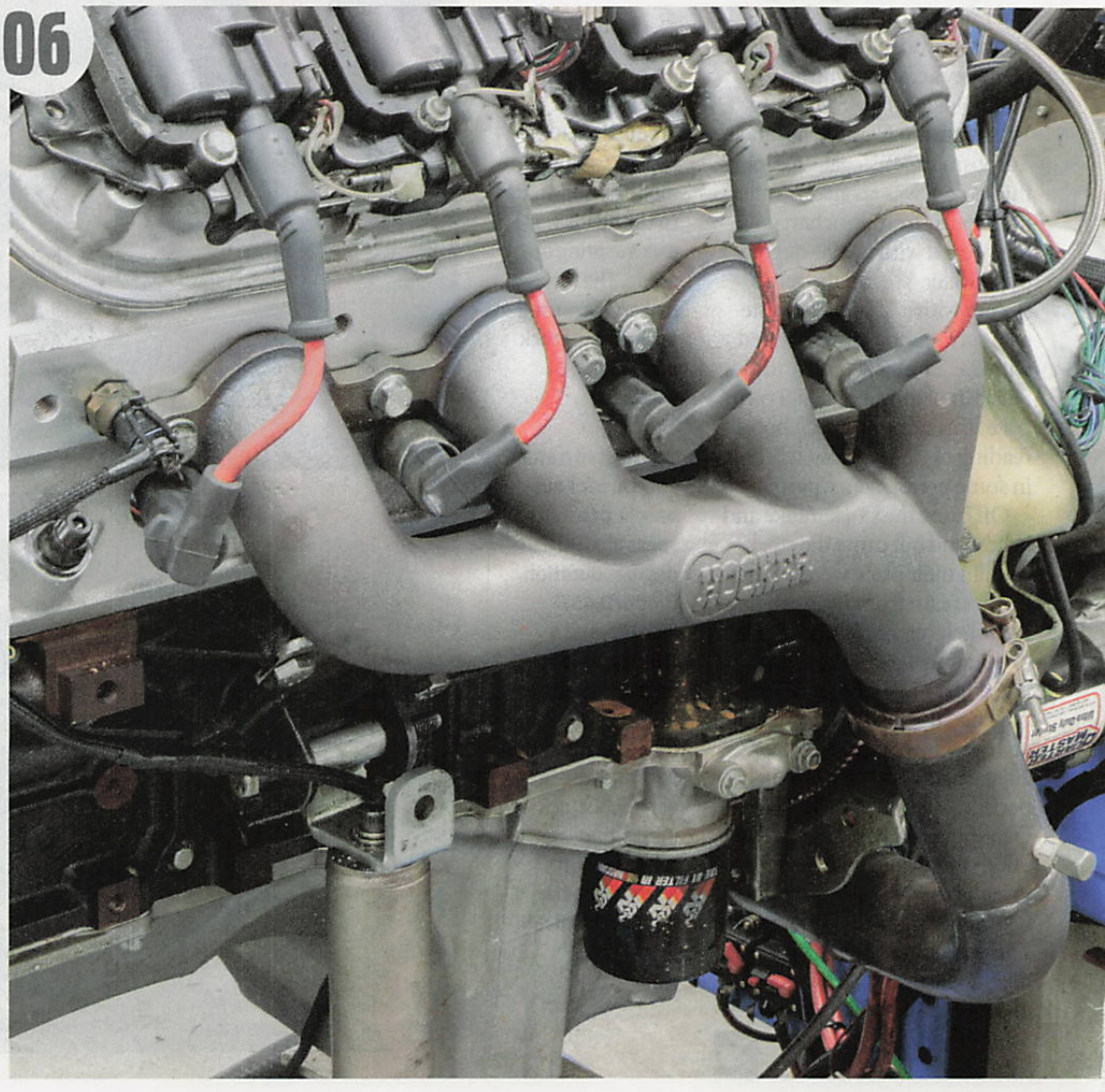


05

and dual valvesprings—easily capable of handling high lift, much boost, and lots of rpm. Next, we added a Sniper Race intake manifold designed specifically for boosted applications, and a matching 92-mm throttle body. The 120-pound Holley injectors were carried over from the first round of tests.

Just like before, we ran the engine naturally aspirated first, and in that configuration we saw 451 hp at a lofty 7,000 rpm, and 379 lb-ft of torque at 5,700 rpm. Though the cam was designed for a turbo application, the combination improved the power output of the stock engine by 118 hp.

05 When run on the dyno in naturally-aspirated trim, the mostly-stock 5.3L produced 333 hp at 5,200 rpm and 359 lb-ft of torque at 4,400 rpm.



06

06 To add boost, we replaced the long-tube headers with these Hooker turbo manifolds. This exhaust featured a crossover (actually under) pipe to join the exhaust from the two banks into a common exit.

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Jason Tabscott
St Race Sm Blk NA
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Randy Heinselman
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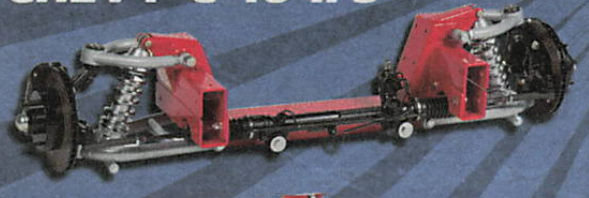

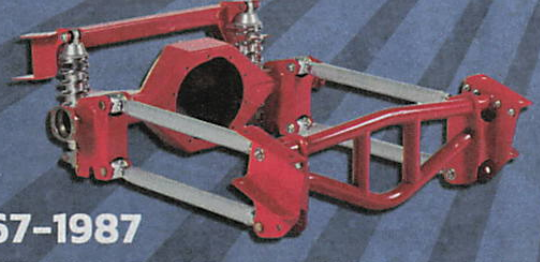

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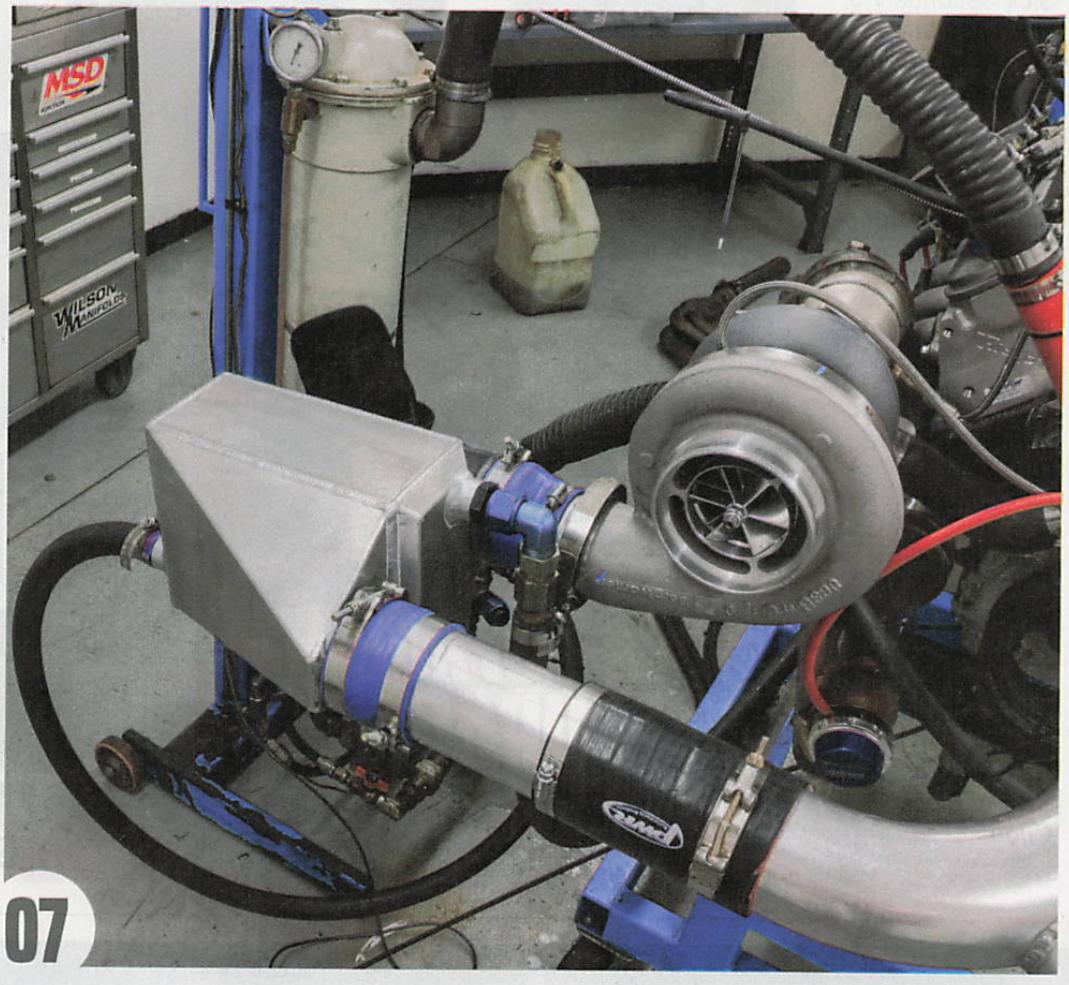
Now it was time for boost. We reinstalled the turbo system used in the first test, and with the same 10-psi wastegate spring, this combination produced an impressive 801 hp at 7,000 rpm and 616 lb-ft of torque at 5,600 rpm. Note that the power and torque peaks on the turbo combination were nearly identical to their naturally-aspirated counterparts, and that the performance parts improved the power output over stock by an impressive 269 hp, though a portion of this can be attributed to the increase in boost (without a change in wastegate spring or any controller), from a peak of 9.6 psi on the stock combo to 11.9 psi on the modified version. Despite the difference in boost, it is obvious that changes in the naturally-aspirated power output are multiplied under boost. The best turbo combinations start out as powerful, naturally-aspirated engines!



07

08

09

07 Our turbo system included a billet wheel, Borg Warner S480 turbo and a ProCharger air-to-water intercooler running 90-degree dyno water

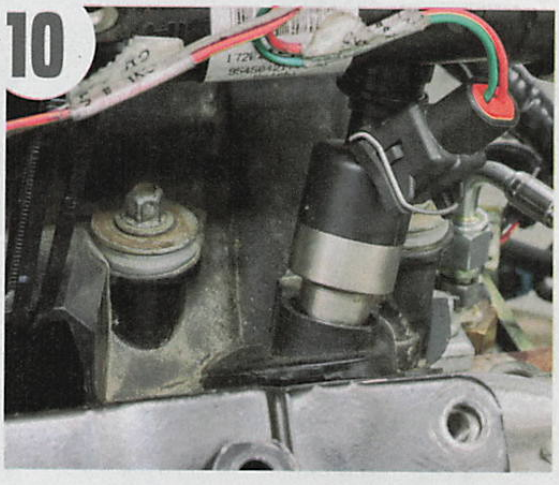
08 Controlling boost was a single Hyper-Gate45 wastegate from Turbo Smart.

09 Turbo Smart also supplied the blow-off valve, designed to help eliminate the pressure spike that occurs on high rpm/boost, lift-throttle situations.

10 To ensure adequate fuel flow, we ran Holley 120-pound injectors on both the NA and turbo configurations of the 5.3L.

11 Run on the dyno with a single S480 turbo producing 9.6 psi of boost on the wastegate spring, the stock 5.3L produced 532 hp at 5,500 rpm and 555 lb-ft of torque at 4,700 rpm.

10



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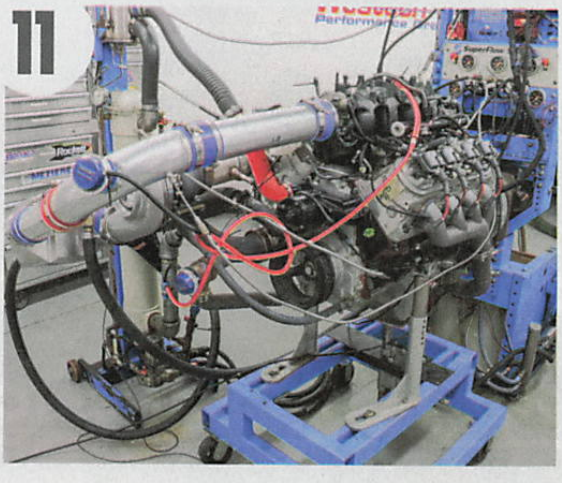
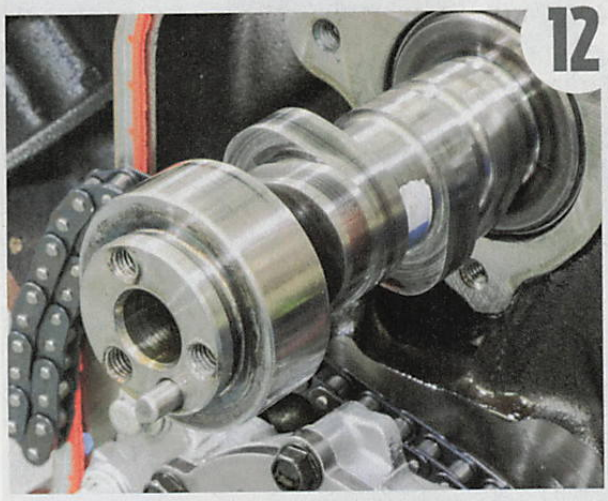




12

14

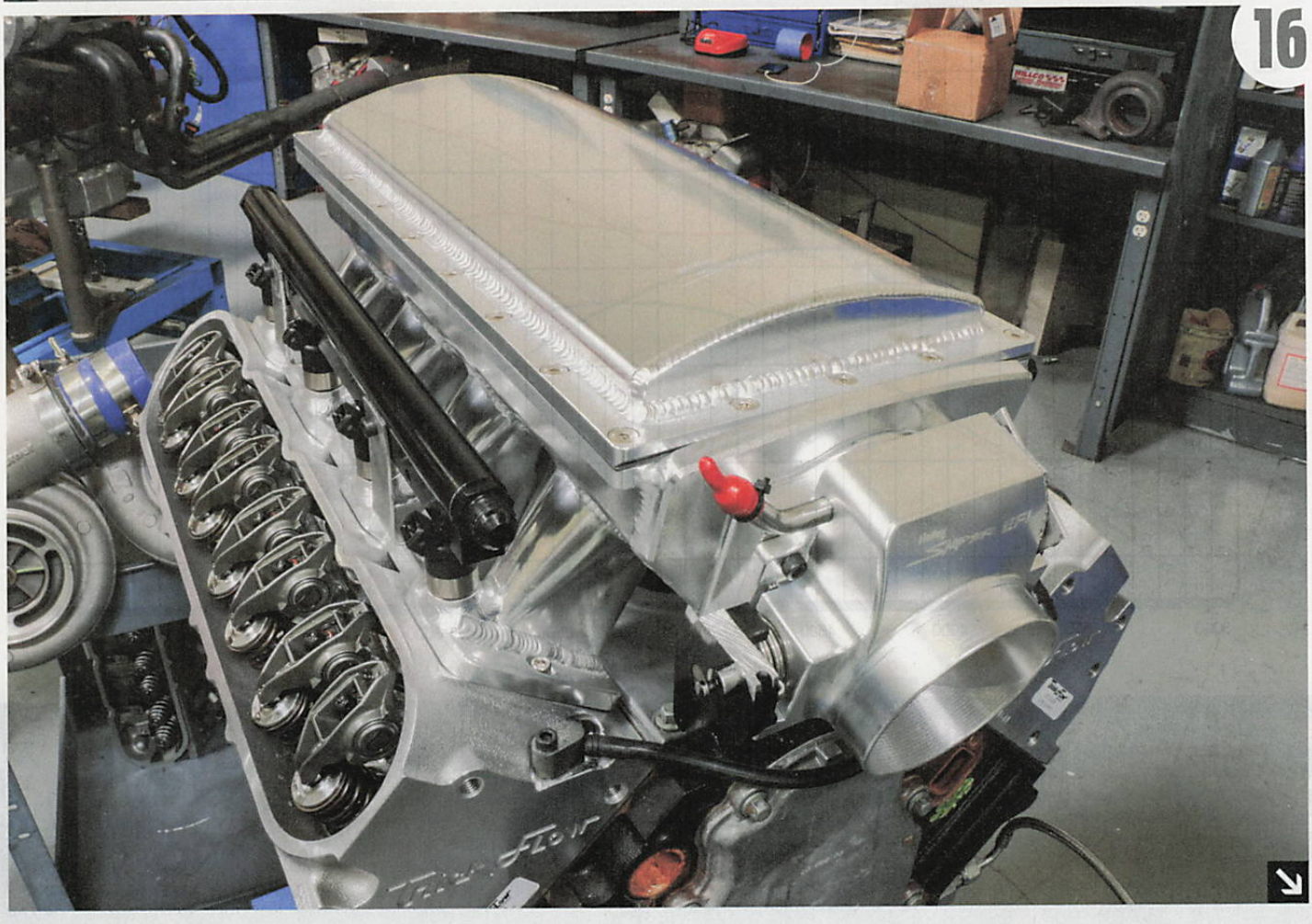
12-13-14 After running the 5.3L with the stock components in both NA and turbocharged configurations, we replaced the stock heads and cam with a Stage 2 Turbo cam from Brian Tooley Racing and Trick Flow Specialties' GenX 205 cylinder heads, which were fully CNC-machined.

15 It was necessary to grind down the factory rocker stands as shown for fitment in the new heads.

16 We topped the modified combination with this Holley Race Sniper intake. With short runners, this intake would certainly push peak power higher in the rev range on this 5.3L.

13

15



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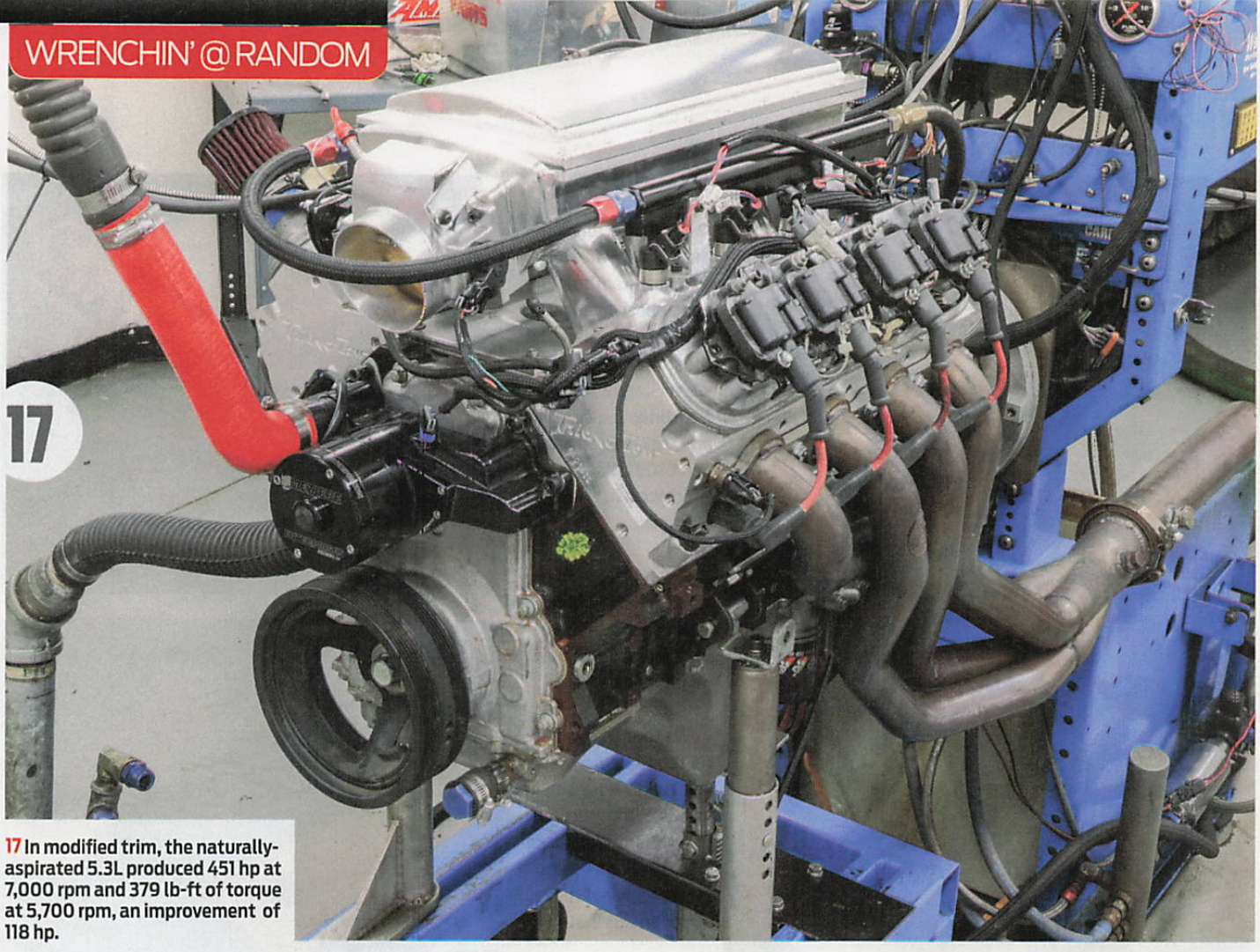
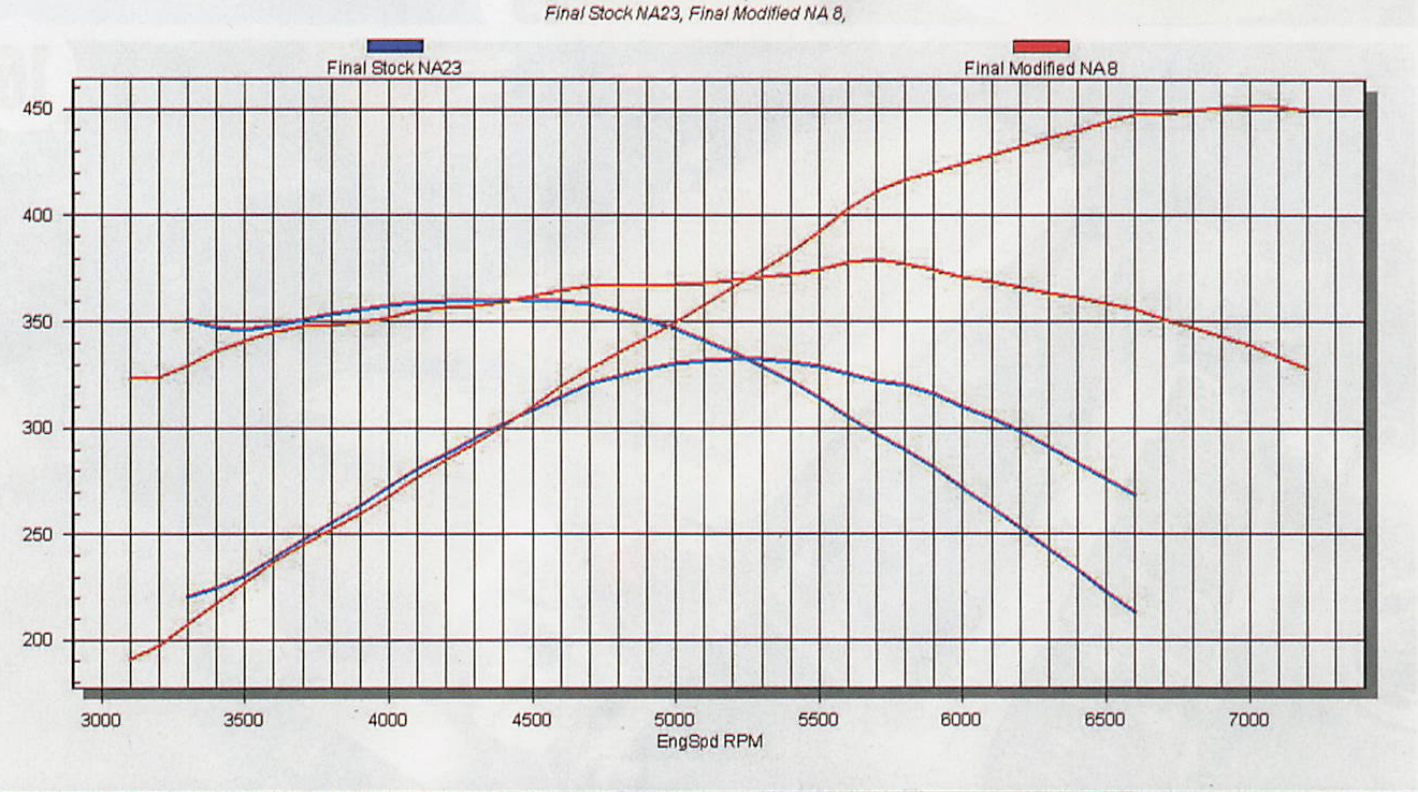


17

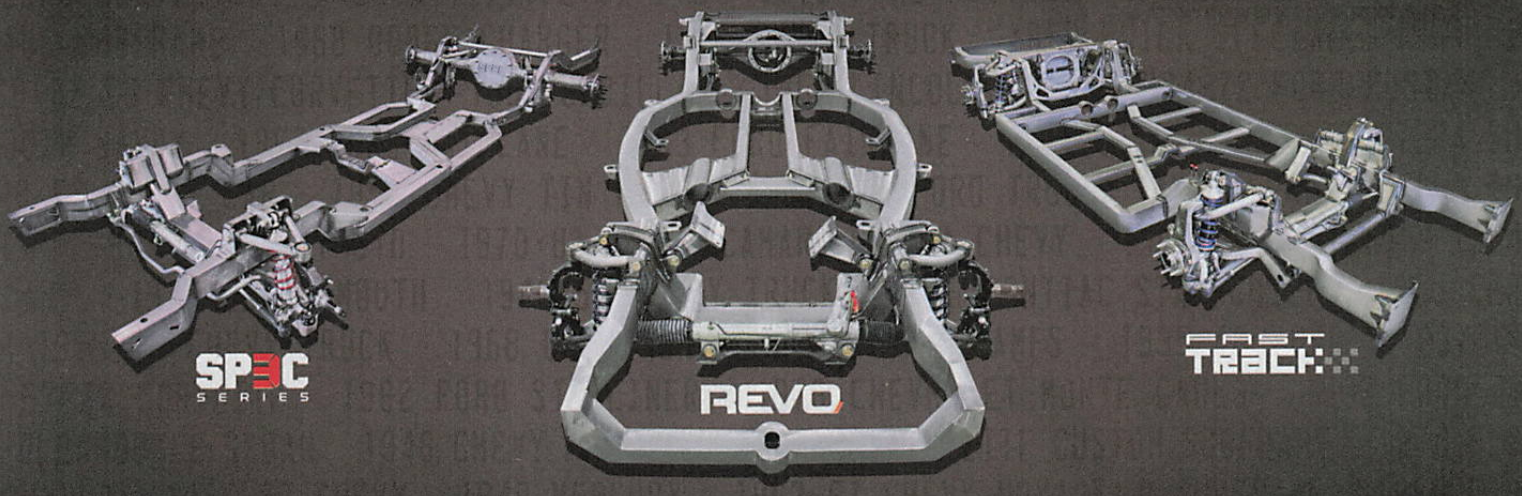
17 In modified trim, the naturally-aspirated 5.3L produced 451 hp at 7,000 rpm and 379 lb-ft of torque at 5,700 rpm, an improvement of 118 hp.



NA 5.3L: Stock vs Modified

We all know how well the LS platform responds to modifications, and this 5.3L was no exception. Equipped with Wiseco forged internals, the 5.3L was first run with a stock LM7 cam, 706 heads, and an early truck intake. By all measures, this was essentially an LM7 with forged pistons and rods, and slightly less compression because of the dished pistons. Run this way, the 5.3L produced peak numbers of 333 hp at 5,200 rpm and 359 lb-ft of torque at 4,400 rpm. Then, TFS GenX 205 heads were installed with a BTR Stage 2 turbo cam and Holley Race Sniper intake. On the dyno, the power output jumped to 451 hp at 7,000 rpm and 379 lb-ft of torque at 5,700 rpm. Though intended more for a turbo application, the parts improved the power output of the naturally-aspirated 5.3L by 118 hp and 20 lb-ft of torque.

NO COMPARISON.
NO COMPETITION.



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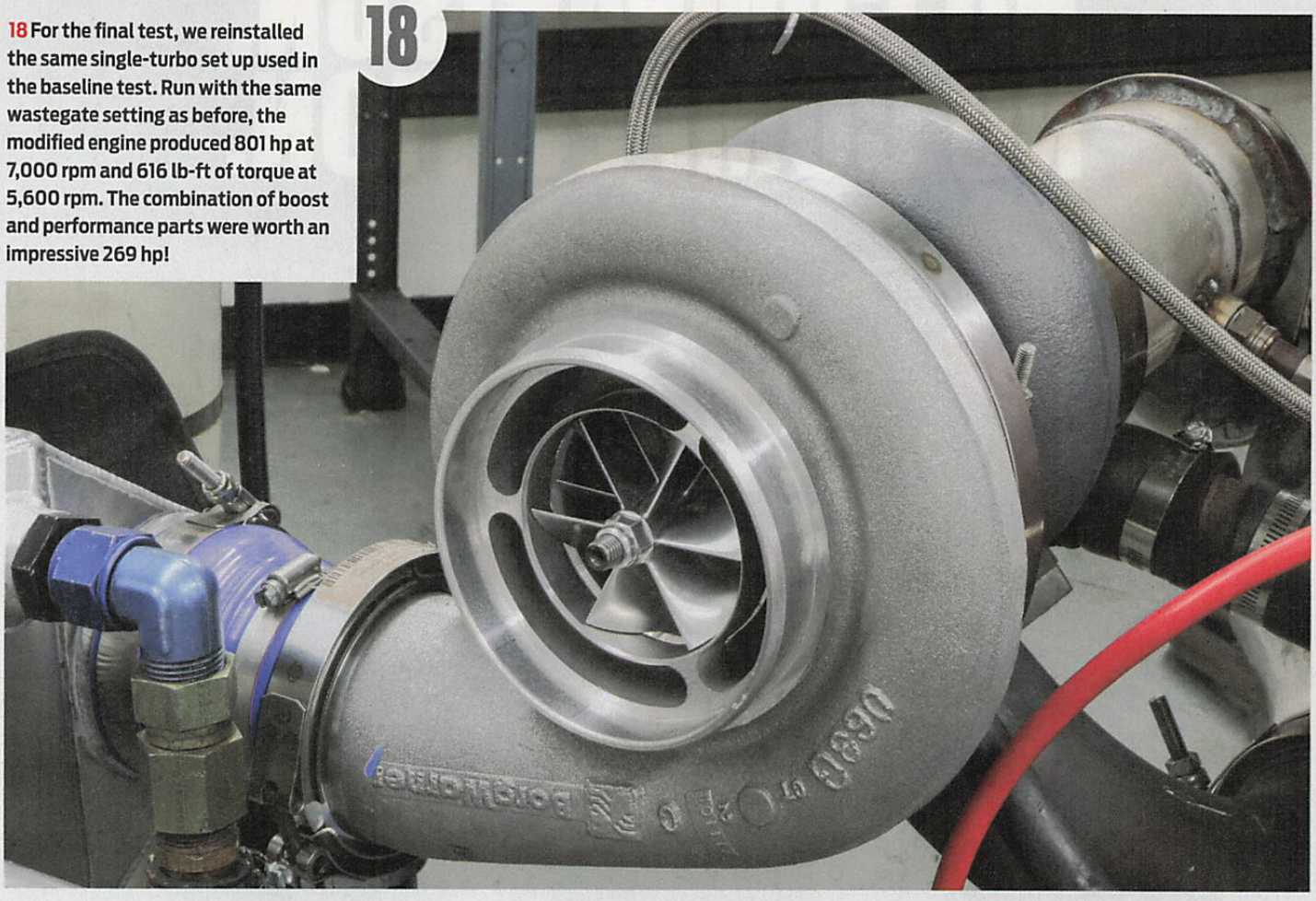
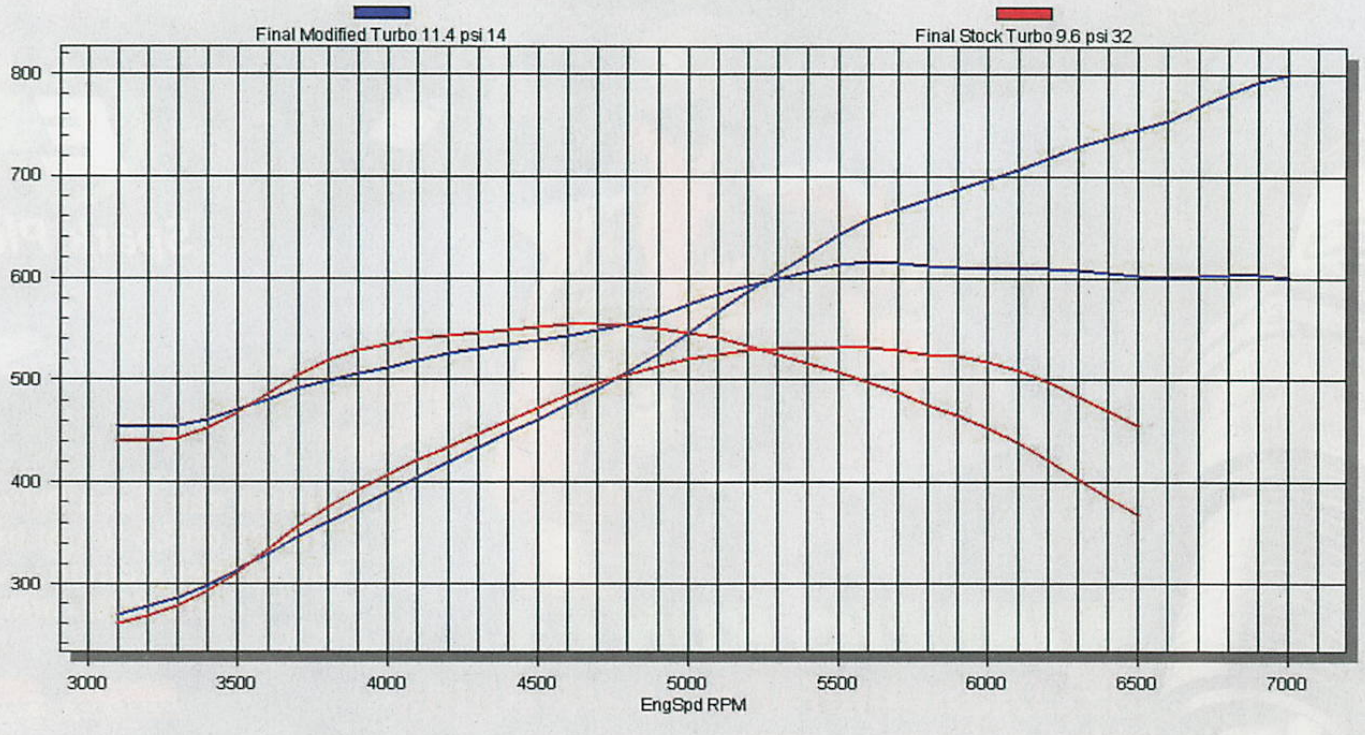
18

18 For the final test, we reinstalled the same single-turbo set up used in the baseline test. Run with the same wastegate setting as before, the modified engine produced 801 hp at 7,000 rpm and 616 lb-ft of torque at 5,600 rpm. The combination of boost and performance parts were worth an impressive 269 hp!





Turbo 5.3L: Stock vs Modified

This test would determine how much of a difference in power we see once we introduce boost to the equation. The 5.3L was run once again in stock trim with a single S480 turbo. Run at a peak boost pressure of 9.6 psi, the turbocharged 5.3L produced 532 hp at 5,500 rpm and 555 lb-ft of torque at 4,700 rpm. We then applied the same turbo system (without changing the wastegate setting) to the modified combination. The result was a jump in power to 801 hp at 7,000 rpm and 616 lb-ft of torque at 5,600 rpm. Despite the same wastegate setting, the boost on the modified combination increased to a peak of 11.9 psi. Run with boost, the modifications were worth 269 hp, though this included an increase in boost pressure of nearly 2.5 psi at the respective power peaks (the equivalent of roughly 76 hp or 30.68 hp per pound of boost).

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Build a 400+HP Vortec 350

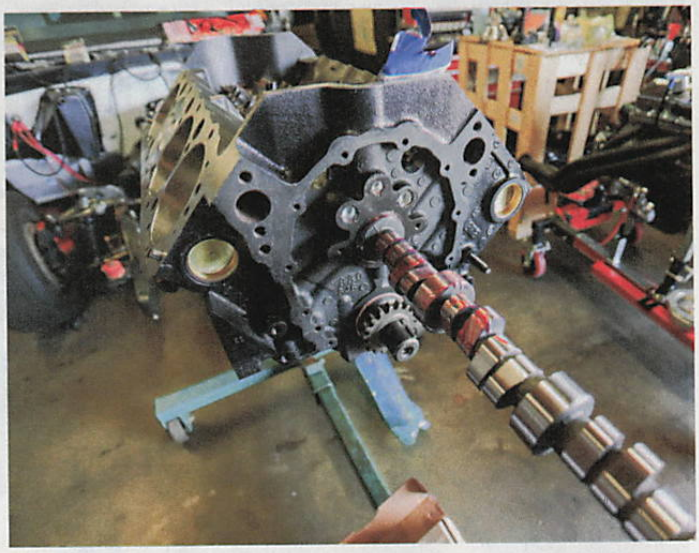
John McGann

We're in a fortunate position here at HOT ROD because people occasionally pitch fun project ideas to us, and this was one of them. Representatives from eBay Motors wanted something cool to put in their display booth at the 2019 SEMA Show, and they asked us to build a couple of engines for them, and this was one of the two. They gave us some general guidelines and a budget to target, so we fired up our browsers and navigated to eBay Motors. One of the goals was to purchase everything needed to build a running engine solely from eBay Motors' vast network of sellers. My assignment was the vintage engine, so I decided to stick with the basics. We all know the latest version of the Gen I small-block is an excellent platform for a performance street build. From the factory, they have provisions for roller cams, they generally have four-bolt main caps, and the one-piece rear main seal isn't prone to leaking like the earlier two-piece design. The Vortec 350 came in hundreds of thousands of Chevrolet and GMC pickups, SUVs, and vans from 1996 to about 1998, so they are easy to find and relatively inexpensive to build. We found a screaming deal on eBay Motors: a rebuilder in Texas was offering rebuilt Vortec short-blocks for less than $1,000. We added the $350 forged piston option and clicked "Buy Now."

The short-block purchased from eBay Motors was shipped from Wholesale-Engines.com fully assembled on a pallet. It's a 0.030-inch over Vortec 350 with four-bolt mains. The base price is $999. We opted to pay an additional $350 for forged Speed Pro flat-top pistons to be added to the stock crank and rods. It was shipped with a full gasket set, a new timing chain, and the stock Vortec camshaft.

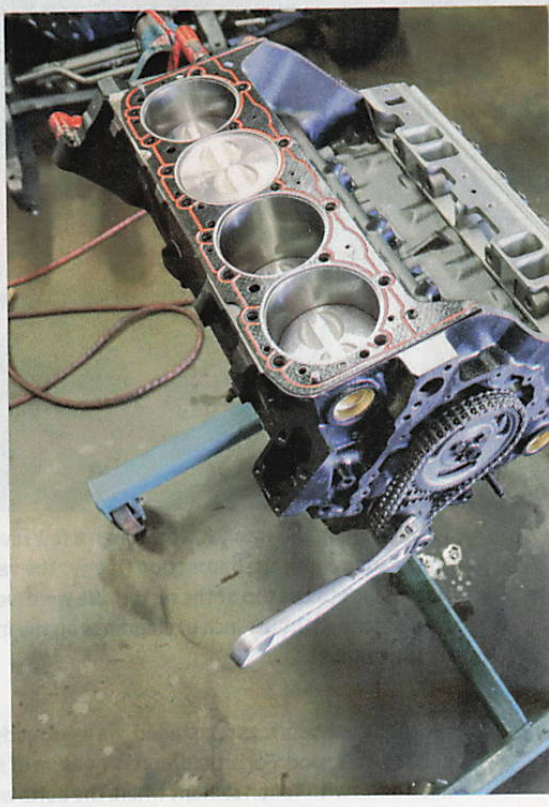
The beauty of starting with a roller cam block is that you're spared the expense of buying conversion roller lifters and new pushrods; all the original parts will work as long as you're not using very high lift cams and excessive spring pressure. We decided to buy new OE-style roller lifters, but bought used tie-bars, pushrods, and hold-down retainer. A new roller cam from Comp completed the valvetrain in our short-block. We then added a good set of cylinder heads, and buttoned up all the ancillary parts before heading to the dyno. We were hoping for about 420 hp from the 9.5:1 compression 355 and were pleasantly surprised when our budget-build Vortec 350 made a consistent 430 hp over and over again.

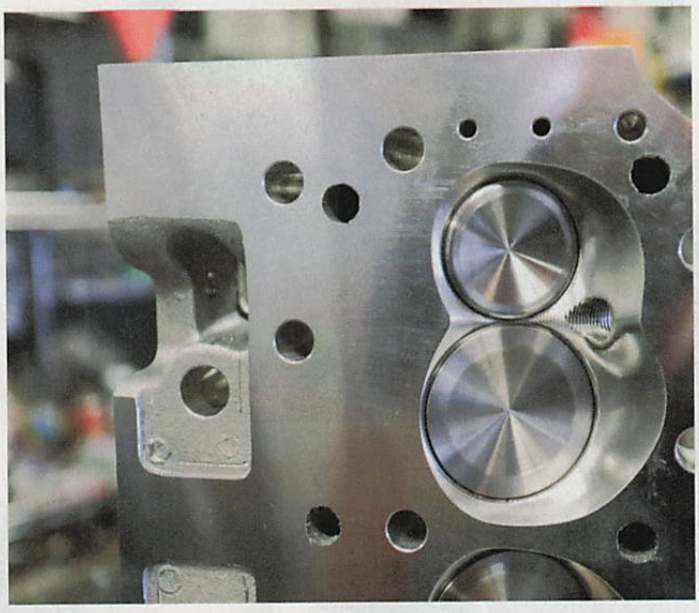
Want to replicate this build for your street machine? Follow along as we assemble this solid, reliable combo.



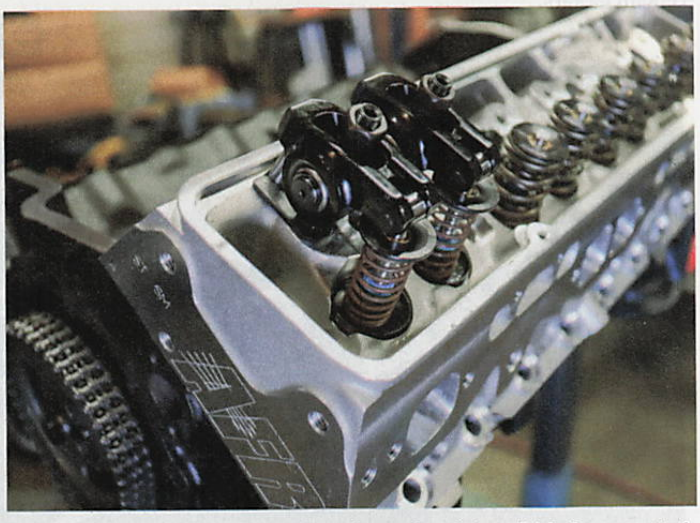
[On the stand in the warehome, we began the assembly by installing COMP Cams' 280XFI HR13. That cam's specs are 230/236 degrees of duration at 0.050-inch of tappet lift and 0.576/0.570-inch valve lift with a relatively wide 113-degree lobe separation angle that works well for fuel-injected applications.

[The stock Vortec cam had a smaller bolt circle and was held in place by a cam retainer plate. Our new cam had the wider, old-style timing gear bolt circle, so we purchased a double roller timing set and a cam button to prevent cam walk. We didn't know it at the time, but Comp P/N SK08-467-8 had the correct stepped nose that would have fit the Vortec's cam gear and thrust plate. Learn from our mistakes!

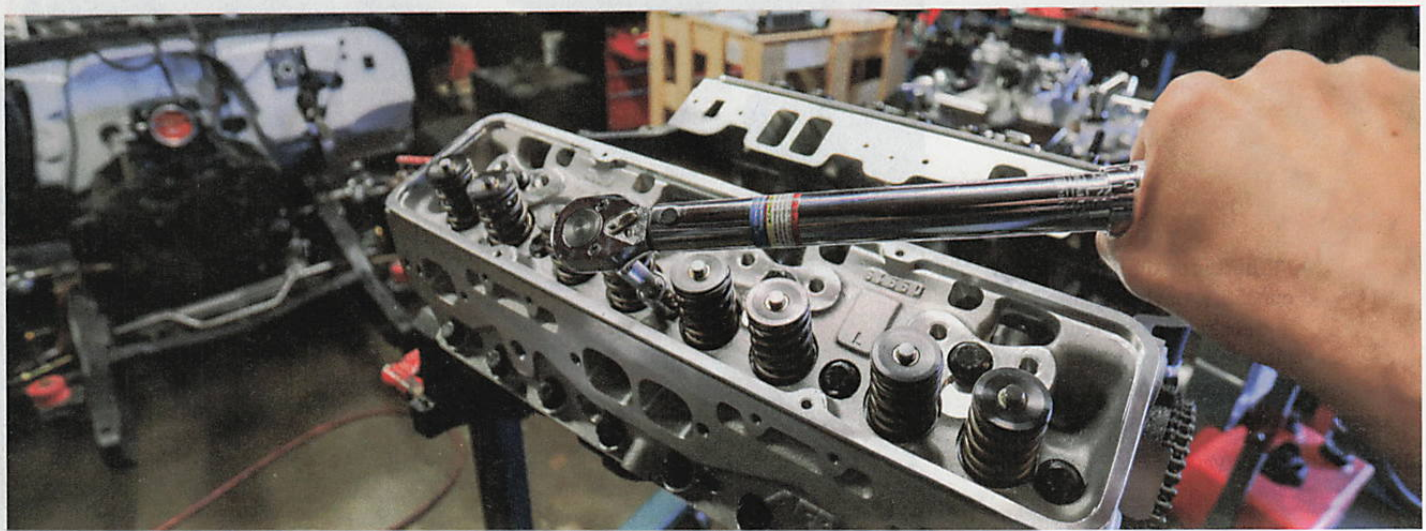


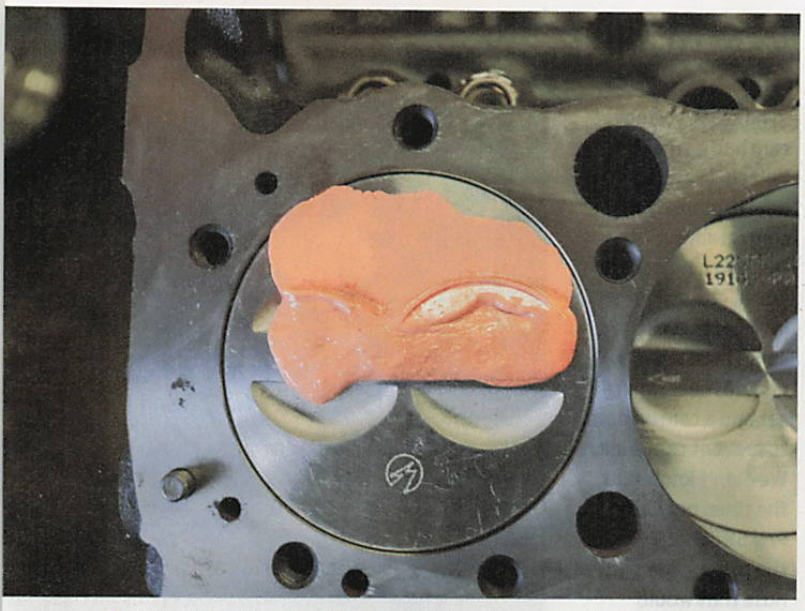


[Aside from the cam, the key to engine power is a good set of cylinder heads. We decided on AFR's 195cc Street cylinder head. A great bang for the buck, they feature 64cc combustion chambers, full CNC porting, and PAC valvesprings with a rate suitable for a roller cam that will accommodate up to 0.600-inch valve lift. According to AFR's website, at 0.550-inch lift, they flow 280 cfm on the intake.



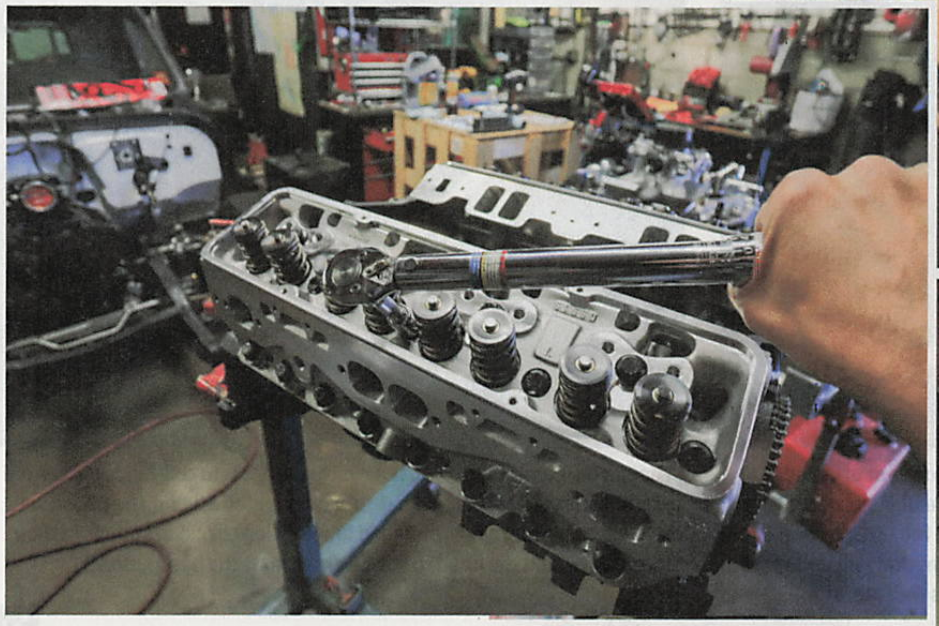
[Though our cam wouldn't put the valvesprings into coil-bind, we wanted to be absolutely sure that piston-to-valve clearance would be OK, so we removed a pair of springs, installed low-tension checking springs in their place, and bolted the head to the block without the head gasket.





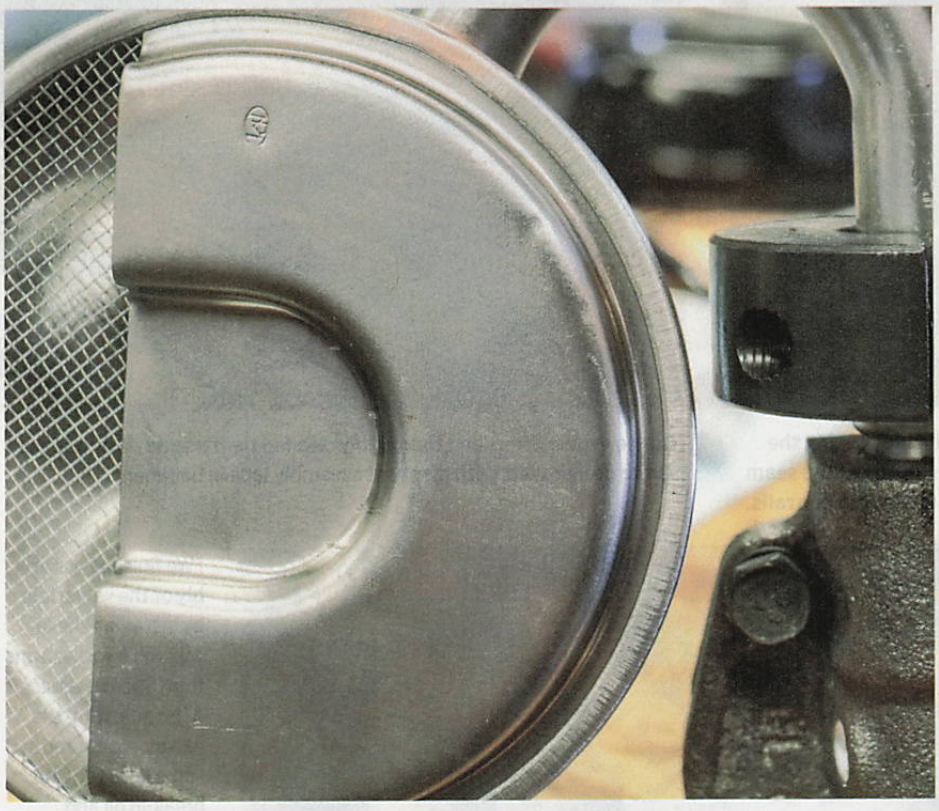
[After turning the crankshaft through a few revolutions, we removed the head to check the impression (if any) the valves left on the Silly Putty stuck to the top of the piston. We were well on the safe side of the recommended 0.080-inch of clearance on the intake side and 0.100-inch on the exhaust.

[With the valvesprings reinstalled, we were ready to put the cylinder heads on for good. For an additional measure of security, we used ARP head bolts with Teflon sealant where the bolts were exposed to the coolant jackets.



[We torqued the heads in three steps, to a final spec of 75 lb-ft, with ARP's bolt lube under the heads of the bolts.

[To button up the bottom end of our 350, we installed the oil pump and positioned the pickup tube in place to measure its clearance to the bottom of the pan.



[After verifying we'd have about 3/8-inch of clearance between the pickup tube and oil pan, we moved the pump to the bench and installed the pickup with a driver tool from Melling, then zapped it in a couple spots with our MIG welder to be doubly sure it couldn't vibrate out.

Parts List

All sourced from ebay Motors

Description	Price
Chevy 350 short-block	$1,349.95
AFR 195cc Eliminator Street Heads #1034	$1,648.03
Comp Cams 12-467-8 280XFI hydraulic roller cam sbc	$291.99
Procomp Electronics PCE229.1005 168T flywheel	$124.50
Oil pan kit	$84.95
ARP High Performance Series Cylinder Head Bolt Kits 134-3601	$83.98
SBC 350 1.5 Ratio 3/8" DNA® Aluminum Roller Rocker	$192.50
Billet Specialties BLK95223 Small-Block Valve Covers – Tall	$140.99
Hydraulic Roller Lifter set	$90.00
Chevy 350 roller lifter hold-down	$40.00
Chevy double roller timing chain set	$22.25
Chevy black timing chain cover set	$19.95
Pushrods	$44.00
Procomp Electronics PCE291.1078 SBC400 6.75" Harmonic Balancer	$63.50
Valve cover, intake manifold, and exhaust manifold gaskets	$46.31
COMP Cams 200 Roller Button	$19.22
Procomp Electronics PCE296.1001 SBC oil filter adapter	$17.45
Serpentine belt drive	$1,234.95
SBC 350 Downdraft EFI Stack Intake ITB Black	$2,266.00
Tight-Fit Small-Block Chevy ZZ-4 Block Hugger Headers, AHC Coated	$219.99
Chevy 350 Ready to Run distributor	$59.60
Distributor hold down clamp	$8.95
	$8,069.06

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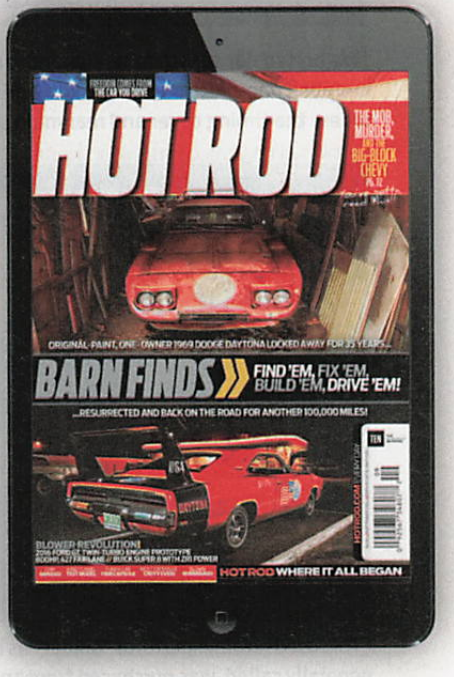

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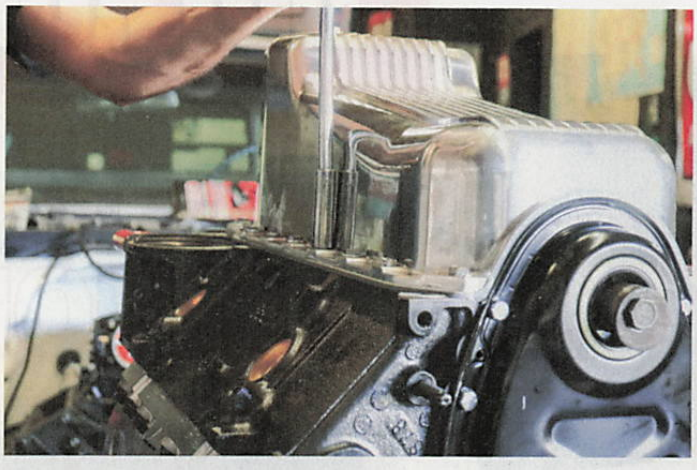
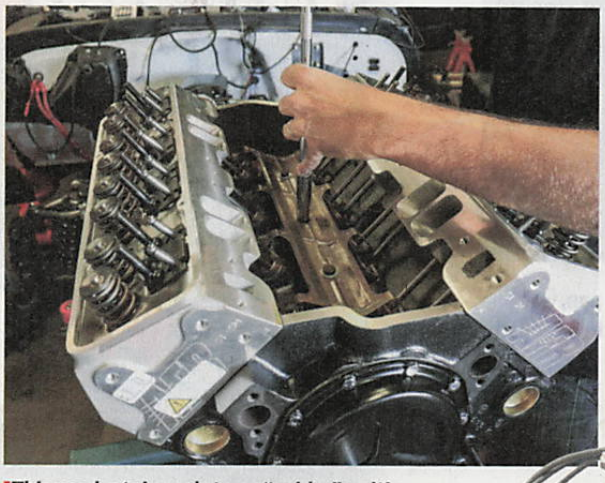


[We bolted our stylish cast-aluminum oil pan to the block using the supplied one-piece oil pan gasket, adding a bit of silicone at the seam where the timing cover and rear main seal adaptor meet the pan rails.

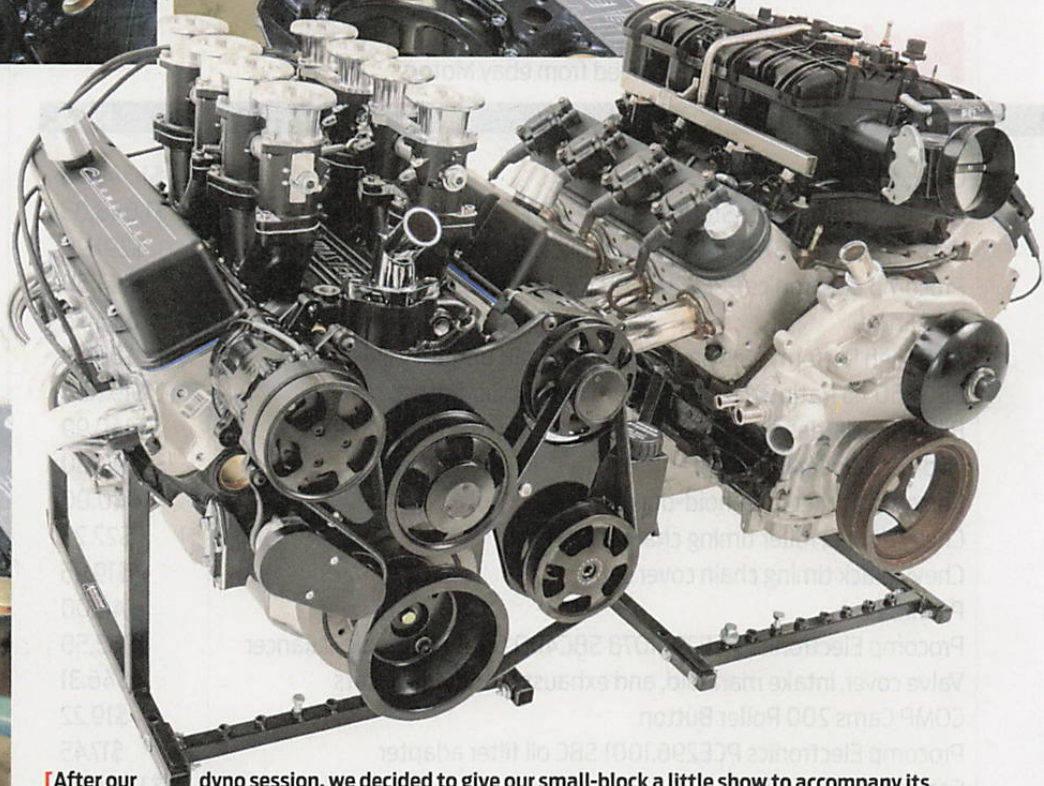
[Our new roller lifters and thoroughly cleaned tie-bars and pushrods were next to be installed, with plenty of assembly lube in between.



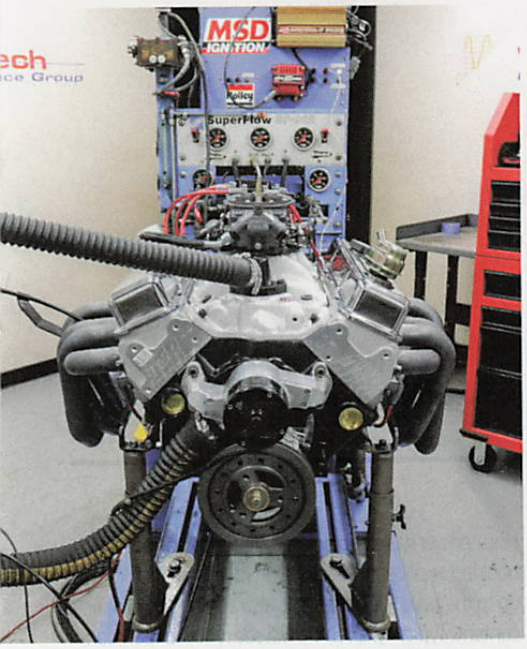
[This used retainer plate, or "spider" as it's generally called, was purchased from an eBay Motors seller, along with the tie-bars and pushrods. It holds the tie-bars in place, which in turn, prevent the lifters from rotating in their bores.

[We finished assembly of the valvetrain by installing these 1.5:1 roller rocker arms from Speedmaster. After adjusting the valves, we poured in some Lucas engine break-in oil and primed the oil pump, happy to see 60 psi on our oil pressure gauge.

[The neutral-balance 7-inch harmonic damper was next, followed by a counterweighted flywheel, which is necessary for the one-piece rear main seal small-blocks. We slapped on some valve covers and trucked our 350 to Westech for its appointment on the engine dyno.



[After our dyno session, we decided to give our small-block a little show to accompany its go. Hey, it is going to be on display at the SEMA Show after all. Therefore, we added a set of Billet Specialties valve covers, a serpentine belt accessory drive, Speedmaster's Downdraft EFI Stack Intake Manifold system, and their small cap billet distributor. The intake drove the price up considerably on our otherwise budget-friendly combination, and you could probably build a version for even less than our single-carb spec by shopping more used parts than we did. Here are our two engines: the Vortec 350 and 6.0L shot in our studio prior to shipping to Las Vegas. We will cover the 6.0L build in an upcoming issue.



[Westech's Steve Brulé recommended running our small block with one of the in-stock Edelbrock Performer RPM dual-plane intake manifolds, a pair of 1¾-headers, and Holley's 750cfm Ultra XP carburetor and our MSD Street Fire HEI distributor. After a brief break-in period, our Vortec 350 made a consistent 429–430 hp run after run. The carburetor needed minor adjustments and the engine seemed to like 33–34 degrees of total timing. There were no leaks, no drama, and the engine pulled hard to about 6,500 rpm.

eBay Motors Vortec 350

RPM	HP	TORQUE
3,000	213	361
3,500	246	370
4,000	310	407
4,500	350	408
5,000	378	397
5,500	410	391
6,000	429	376
6,500	425	343

Sources

ARP;
805.339.2200; ARP-Bolts.com

COMP CAMS;
800.999.0853; CompCams.com

EBAY MOTORS; eBay.com

SPEEDMASTER;
909.605.1123; Speedmaster79.com

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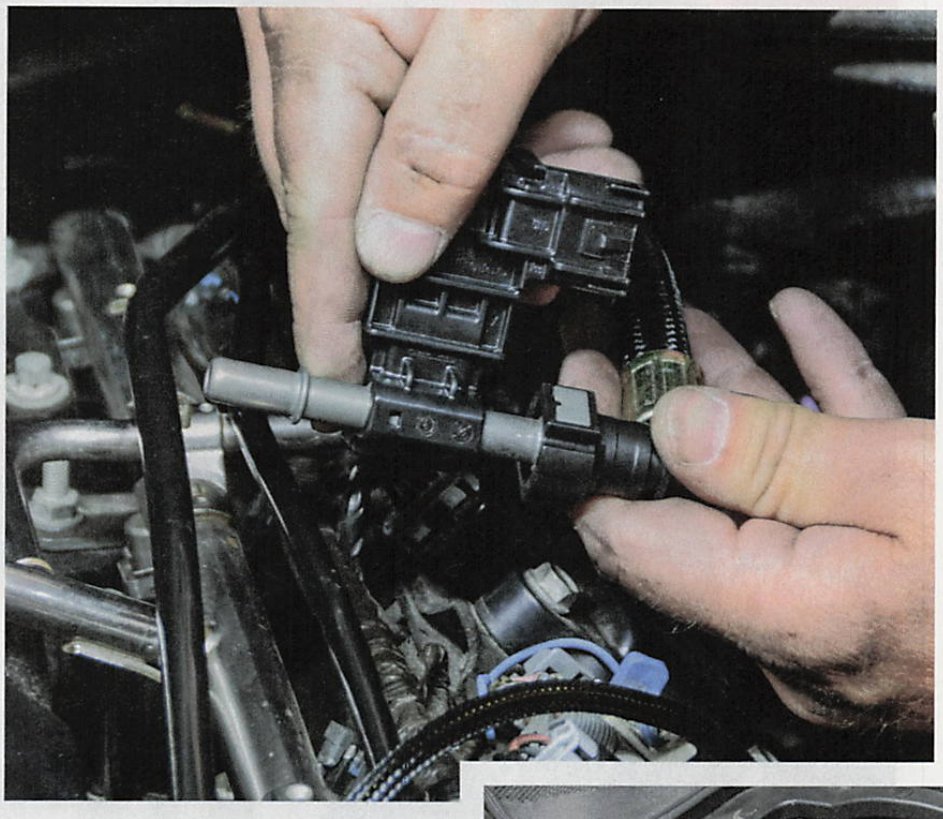
FLEX FUEL

Tommy Lee Byrd

SWITCHING FROM GASOLINE TO E85 (AND BACK) HAS NEVER BEEN EASIER



The case for ethanol-enriched fuel has been highly contested within the car community. Some people love E85, and some people wish that 100-percent gasoline was still the norm. The corn-based fuel component offers several advantages, such as a much higher octane rating, but the tuning aspect has frightened a lot of folks away from making the switch. Ryan Truax experienced this firsthand. He converted his car to E85 and went through the process of a custom tune, only to find that the car was inconsistent. Sometimes it would be rich, and sometimes it would be lean, so he dug a little deeper and found that the fuel from his local E85 pump did not always have the same ethanol content. This discovery led him to create Advanced Fuel Dynamics, a Texas-based company that builds plug-and-play flex-fuel conversions. The heart of the system is the Commander module, which, in combination with a GM Flex Fuel sensor, tells the injectors how much fuel to provide, based on the amount of ethanol detected in the fuel system in real time. The Commander features infinitely-adaptive ethanol tuning maps, so it can tune for any blend of gasoline and ethanol, and with the ProFlex Connect app, you can view your real-time ethanol mixture as you're driving down the road.

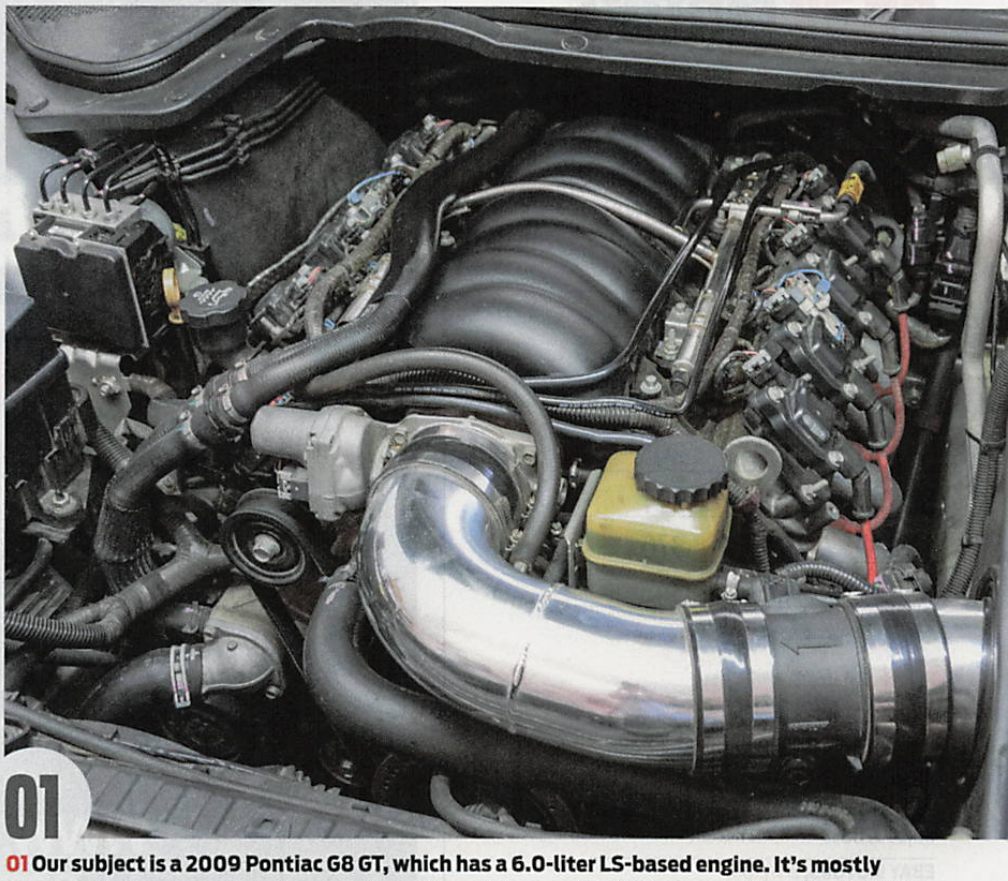
With dyno testing Advanced Fuel Dynamics has seen the most gains from 80-percent-or-higher ethanol content, but the Commander system adds power even when the ethanol content is less than 50 percent.

Source

ADVANCED FUEL DYNAMICS; 866.902.3835; www.advancedfueldynamics.com

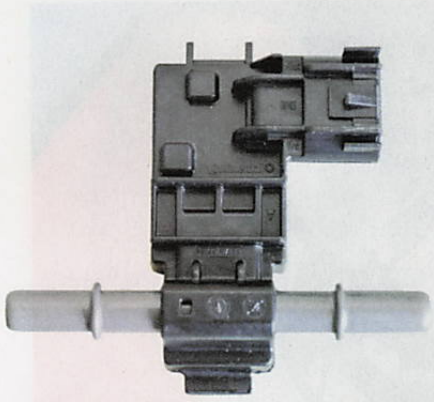
Horsepower gains can be even more dramatic on boosted applications, as long as your fuel injectors are up to the task. Fuel mileage is also affected by ethanol content. Typically, a vehicle will see reduced fuel economy when running E85, but the trade-off is that E85 is less expensive than most 93-octane pump gas.

To get a taste of this flex-fuel phenomenon, we installed the ProFlex Commander on a mildly-modified 2009 Pontiac G8 GT, which is powered by a 6.0-liter LS-based engine. We spent about an hour and installed it in our driveway. Advanced Fuel Dynamics manufactures direct-fit kits for dozens of applications, making it easy to convert any LS or Coyote-powered vehicle to flex fuel. In our application, we were most pleased with the fact that we gained seat-of-the-pants horsepower with a one-hour installation and no tune-shop drama. The fear of dedicated E85 conversion is all but gone, and we can take advantage of added horsepower whenever we want.



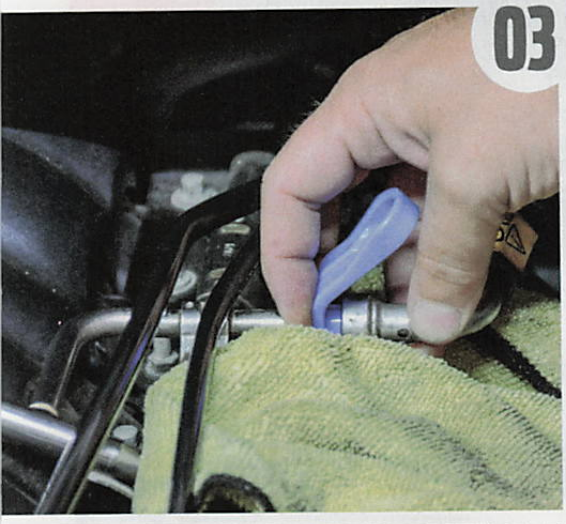
01

01 Our subject is a 2009 Pontiac G8 GT, which has a 6.0-liter LS-based engine. It's mostly stock, aside from simple bolt-on modifications. Advanced Fuel Dynamics offers direct-fit kits for several applications as well as generic kits for engine-swapped vehicles. The product line covers GM, Ford, Mopar, BMW and Mercedes.



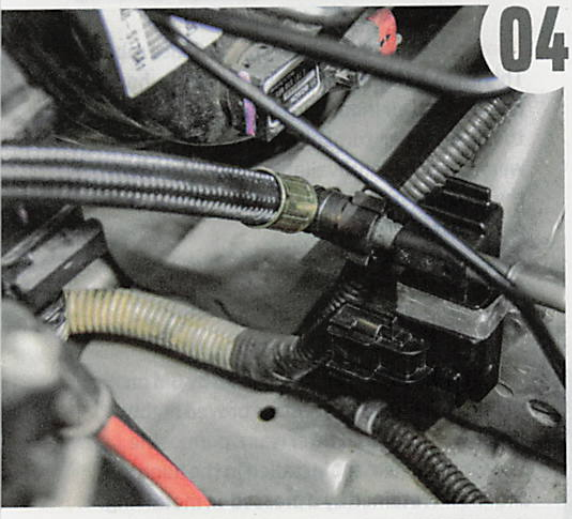
02 A major component in the Advanced Fuel Dynamics ProFlex Commander kit is the flex fuel sensor. This is an OE part (GM PN13577429) that is installed in-line with your existing fuel system.

03 To get started, we need to disconnect the original fuel line from the fuel rail. For most modern applications you'll need a special tool to disconnect the quick-connect fitting. It may leak a little fuel, so be prepared with a towel.



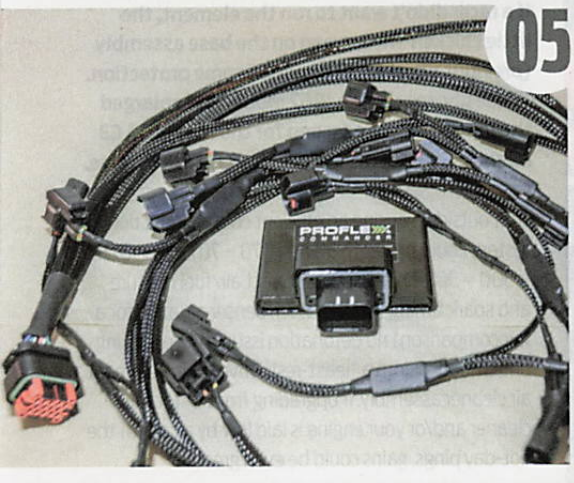
04 The Advanced Fuel Dynamics kit comes with two sections of flexible hose with fittings already installed. After mocking up the fuel line routing, we made a small bracket out of aluminum to securely fasten the flex fuel sensor to the car. Now, we can simply push the new fuel lines into place. One hose goes from the existing hard line to the sensor; the other hose goes from the sensor to the fuel rail.

05 The ProFlex Commander unit and flex fuel sensor tell the injectors how much fuel the engine needs based on the ethanol content detected by the sensor. The wiring harness plugs into the flex fuel sensor, then has two groups of wires that connect to the fuel injectors.



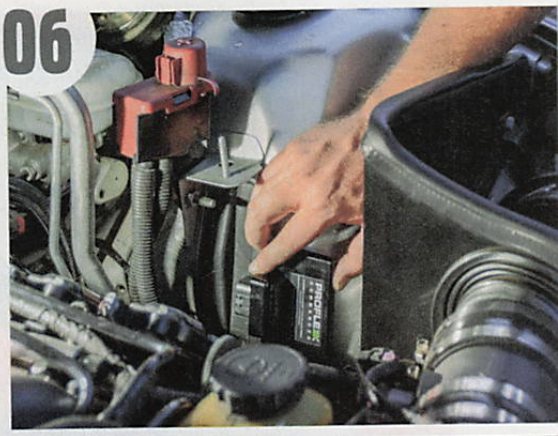
06 The Commander module has double-sided tape already installed, so we chose a nice flat area on the inner fender so that the adhesive would have a good contact patch. We were also mindful of which direction the wires needed to run, in order to perform a clean install.

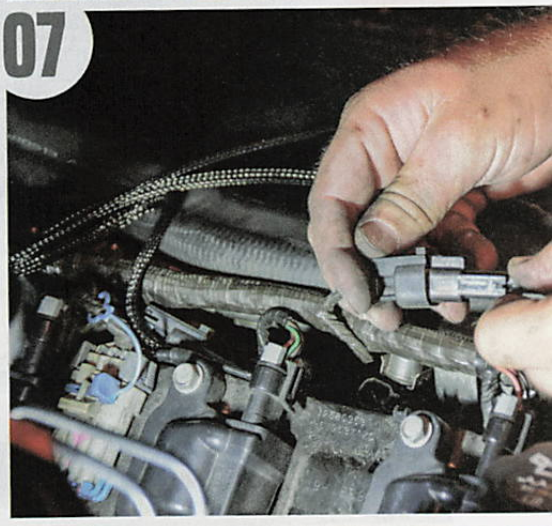
07 The injector wiring harness is easy to install, as the connectors can only be installed one way. The harness plugs directly into the car's original injector harness.

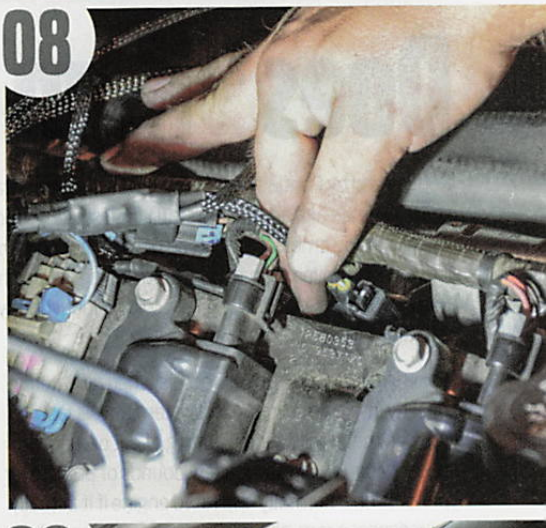


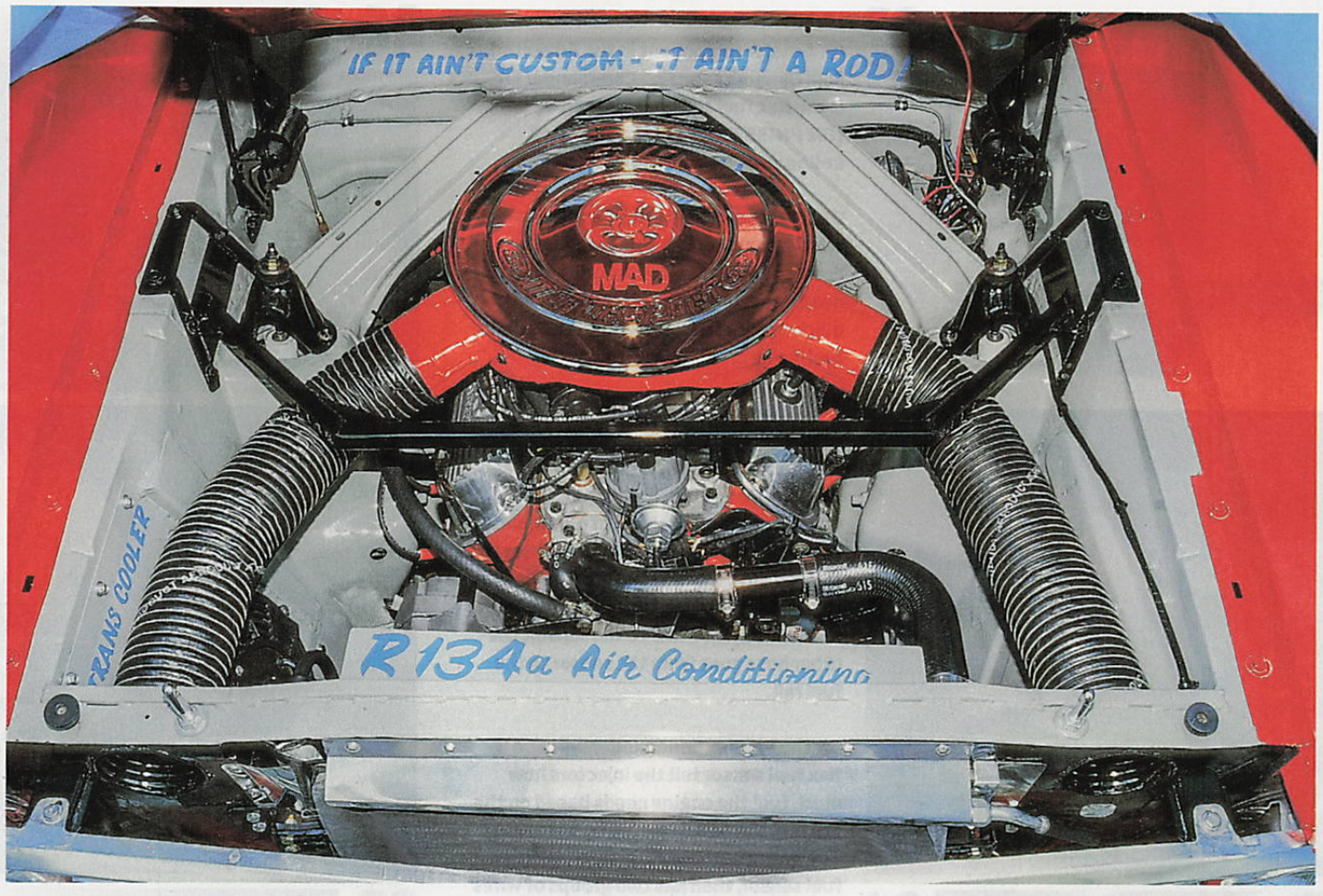
08 After the injector harnesses are connected, we simply plug the connectors from the new harness into the fuel injectors. Then, we can tuck the wires for a nice, clean appearance.

09 The best part about the Advanced Fuel Dynamics ProFlex Commander kit is the fact that no custom tuning is necessary. You can simply turn the key and go to your nearest E85 pump. Switch back and forth between ethanol and pure gasoline with no programming, no tuning, and no drama, then view your real-time ethanol content with the ProFlex Connect app.









Does "Ram Air" Work?

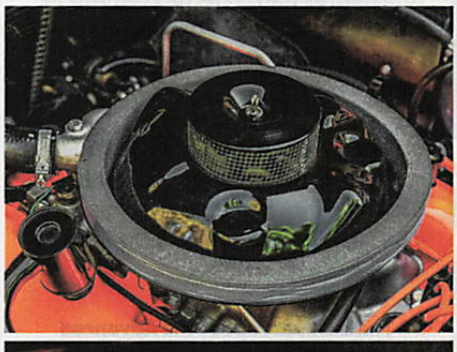
Popularized by Pontiac back in the 1960s, the term "Ram Air" (as used by its space cadets—aka advertising staff) for a sealed induction system that receives cooler outside ambient air instead of really hot underhood air is a misnomer—at least when applied to road vehicles traveling at legal highway speeds. The correct term—although a lot less sexy—is "cold air induction system." There is a difference; let's break it down.

Marlan Davis
Marlan Davis and HOT ROD archives

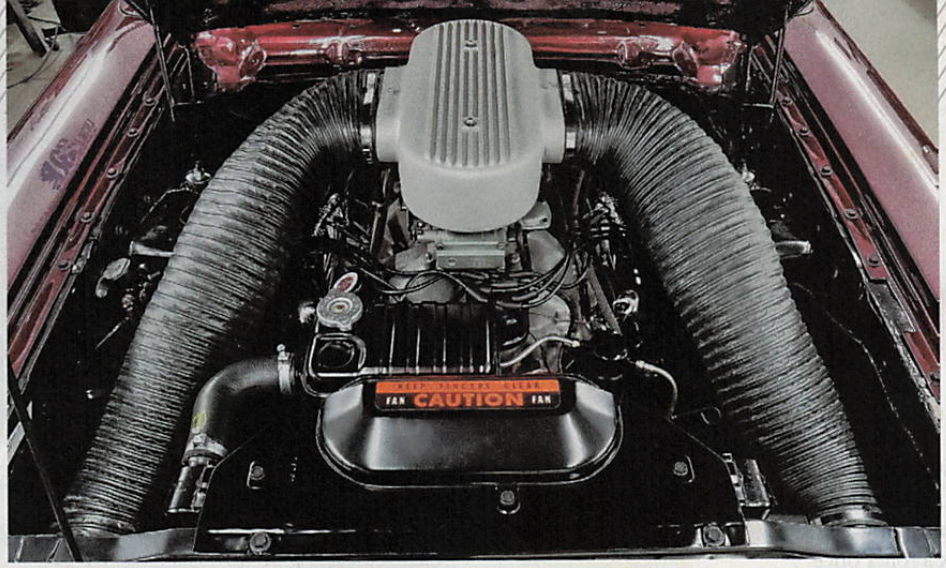
Above: Not the repurposed *Lost in Space* robot: This is Mark Hamilton's highly effective, home-brewed cold air induction system he built in the 1980s when turnkey aftermarket systems weren't yet widely available. He already had the air cleaner, and 30 years ago the rest of the parts cost under $50.

For engineers, true "ram air" occurs when air entering directly into the fuel metering system travels fast enough that a mild supercharging effect occurs—a boost gauge would show a few pounds of positive air pressure on a normally-aspirated engine if it actually experiences a ram-air effect. The operative term here is "fast enough": Ram air only becomes effective at high speed, providing about 1.2% horsepower improvement at 100 mph, 2.7% at 150 mph, and 4.8% at 200 mph.

On the other hand, cold air induction is highly effective at street-legal highway cruising speeds. A true, sealed cold air induction system receives outside ambient-temperature air instead of hot engine-compartment air. Ever since the late 1970s, even box stockers have used some sort of cold air induction due to ever-increasing underhood temps. Every 10-degree F temperature drop is worth a 1% power gain. For example, if the underhood temperature is 170 degrees and the ambient (outside) air temperature is 70 degrees, a 500hp engine capturing that outside air using an efficient cold air induction system could be worth 50 hp [(170 – 70) ÷ 10 × 0.01 × 500 = 50]. This assumes correct air/fuel mixture and spark timing for the colder, denser air, and (for a fair comparison) no detonation issues when sucking underhood air into a "least-restrictive" open-element air cleaner assembly. If upgrading from a stock air cleaner and/or your engine is laid low by a case of the hot-day pings, gains could be even greater.



Left: The weird cold air setup used by GM on real 1967–1970 L88 Corvettes proved highly effective. The actual filter was a permeable foam rubber element installed in the hood's airbox and retained by a pressed-in metal ring. If a racer didn't want to run the element, the little chicken-wire screen on the base assembly (*previous photo*) still provided some protection. These photos show a 1967 model. GM enlarged the rear-facing hoodscoop for the new 1968 C3 models, making the system even more effective.



Cold air induction downsides include possible carburetor icing in winter; harder cold starts on nonelectronically-managed engines; and possible dust, debris, and water ingestion. Many factory cold air setups used a thermal valve referenced to exhaust heat, which blocked the engine from receiving cold air until it warmed up.

In the factory muscle-car-era, styling often took precedence over maximum efficiency. The scoops were generally too small and in the wrong location. The best places to pick up cold air without a gigantic drag-race style, tall hoodscoop are: at the base of the windshield, underneath the front bumper, at the front grille (on traditional cars with broad front grilles), through repurposed quad-headlight system inner bezels (à la the legendary 1964 Ford Fairlane Thunderbolts), or (as in many late-models) from the inner fenders. To provide a stable metering signal, ducts should feed a sealed airbox or air cleaner assembly, not pipe directly into the carburetor or into the air meter.

The no compromise 1964 Ford Thunderbolt cold air system: Air enters the inlet ducts through what used to be the inner headlight bezels, feeding a big airbox that surrounds twin Holley four-barrel carbs.

Want to fab your own cold air system? Consider Mark Hamilton's setup on a 289-powered 1965 Falcon, circa late 1980s. As shown in the photo, the basis is a once widely available 1985 5.0L-HO Mustang dual-snorkel air cleaner. That model still came stock with a Holley four-barrel carb, so the air cleaner's base fits anything with a 4150-style air cleaner ring. Hamilton sectioned and enlarged the original air cleaner inlets to mate with 4-inch-od Aeroduct "CAT" flexible ducting. Aircraft Spruce and other aftermarket sources sell Aeroduct by the foot in a variety of diameters from ¾ to 6 inches and in a choice of varying heat resistant material configurations. Upstream, at the inlet end, the ducting connects to cut-down Del Monte fruit cocktail cans with a 4-inch base (thicker and stronger than coffee cans) welded into the radiator core support. Today, aftermarket specialty outfits like Air Inlet Systems have everything you need under one roof, including airboxes, ducting, and pop-in core-support pass-throughs.

Sources

AIR INLET SYSTEMS
HAMILTON, ON, CANADA; 905.549.6135
RamAirBox.com

AIRCRAFT SPRUCE & SPECIALTY CO.
CORONA, CA; 877.477.7823 (orders), 800.861.3192 (customer service), or 951.372.9555 (outside USA)
AircraftSpruce.com

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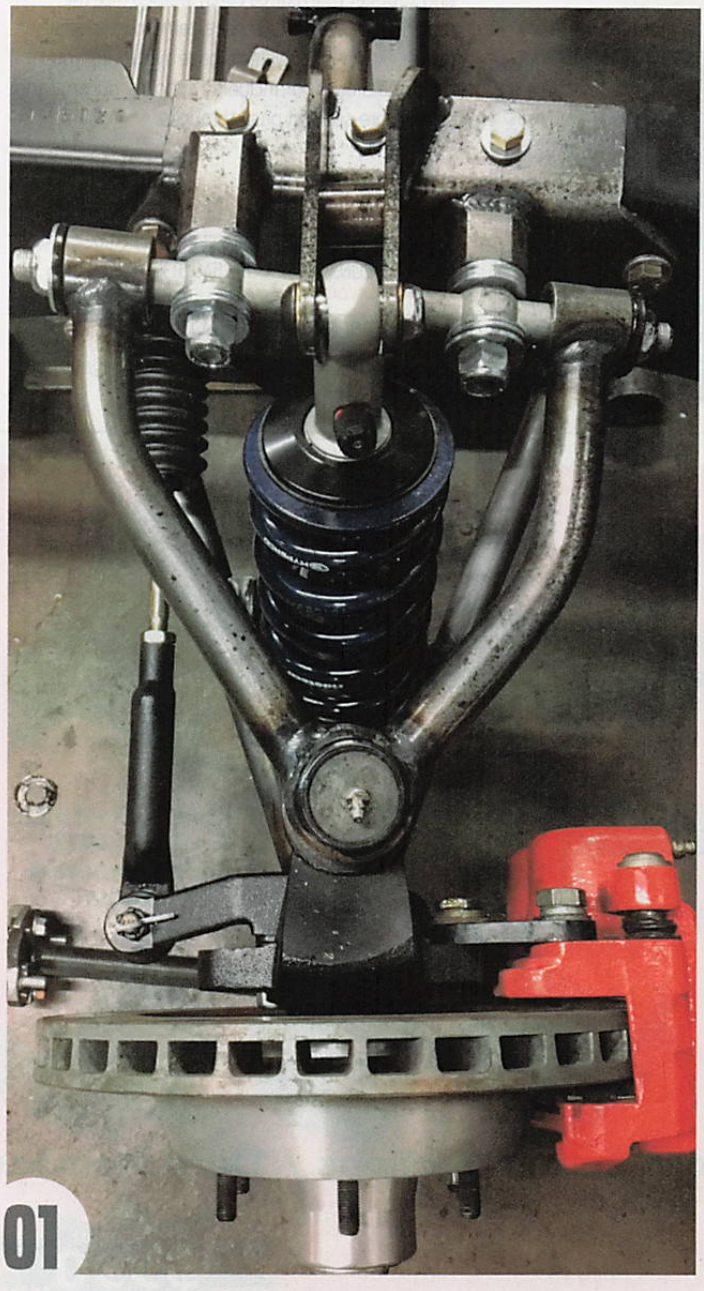
Shop Talk
Project Update

John McGann

Here we go with part two of the coilover suspension conversion on our 1967 Chevy C10 project, Truck Norris. This time around, we finish the job by installing TCI's rear suspension components and make the truck a roller once again. The work was straightforward, and we performed it all at home with the vehicle on jackstands. Our air hammer sure got a workout, though. Let's see how it all went down.



01 To recap, we're replacing the C10's entire suspension with components from Total Cost Involved. The front suspension consists of a tubular engine crossmember and motor mounts, tubular upper and lower A-arms, new spindles, rack-and-pinion steering, and coilover shocks. The spindles accepted the CPP disc brake conversion we had performed several years ago.

02 We like TCI's rear suspension system because it retains those distinctive, long trailing arms that the '63-'72 Chevy pickups are known for. The kit replaces the stock I-beam trailing arms with a pair of tubular trailing arms and adds a torque arm and full-width Panhard bar. The c-notch frame plates are also included.

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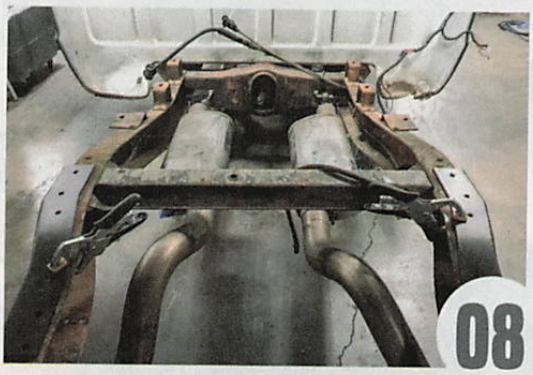
03 I suppose the suspension work could be done with the bed on the truck, but only a masochist would attempt to do so. We siphoned the gasoline out of our FuelSafe cell, disconnected the fuel lines and wiring, and used our engine hoist to remove the bed.

04 Space is at a premium at our 1,200-square-foot warehome, so we came up with what seemed like a clever way to store the bed out of the way, hoisting it up to the ceiling with a block and tackle hanging from the rafters.

05 Disassembly of the rear suspension was the easy part. With the trailing arms and axle housing out of the way, the next step involved making a lot of racket with our air hammer. We also had to cut out that sweet home-brewed, chassis-stiffening bar we welded in a couple years ago.

06 Using TCI's instructions, we marked all the frame rivets that needed to be removed and then spent the next several hours with our new friend, the air hammer. We believe the most efficient way to remove the rivets is to shear the heads off with a very sharp chisel bit, then drive the shank out with a punch.

07 This is a time consuming (but oddly satisfying) process because there are several brackets and crossmembers to be removed, and all of them are attached to the frame by multiple rivets.



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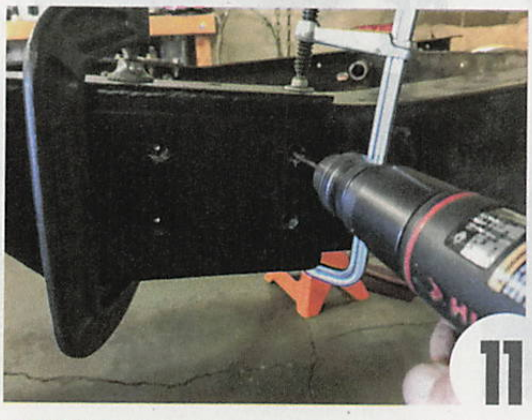

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08 With the unneeded brackets and crossmembers removed, we began the installation process by clamping the c-notch brackets to the frame and marking the sections to be cut out.

09 We did one side at a time, cutting the clearance for the c-notch and bolting the new brackets in place. We also took care to measure that both c-notch plates were parallel with each other and to support the frame in front of and behind the section to be cut.

10 The c-notch kit consists of upper and lower plates that bolt to each other and then to the frame. They align with some existing holes in the frame, but the remaining mounting holes need to be drilled. It helps to clamp both plates tightly in place before drilling the holes.

11 We nearly overheated our cordless drill before switching to our pneumatic drill. It helps to have a very sharp drill bit for this job. Keep the drill's speed slow and keep the bit lubricated with penetrating oil or similar. Start with a small pilot hole, then switch to bigger bits as you go along.

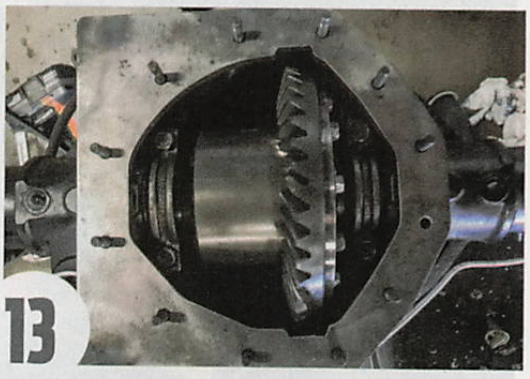
12 We took the time to clean and paint the frame to match our new parts. Here, all the suspension mounting components are installed: the c-notch plates, shock mounts, and Panhard bar crossmember.

13 The center torque arm bolts to the axle housing via a plate that is sandwiched between the housing and differential cover.

14 We slid the axle back under the frame in the approximate position it will be located and installed the new trailing arms and torque arm. You can see that we will have to modify our exhaust since the right-side muffler will be competing with the torque arm for the same piece of real estate.

15 & 16 Before torquing any of the suspension fasteners, we verified the axle housing was centered between the framerails and square in the frame, all while making sure the frame was level to the ground at our intended ride height. We also set the pinion angle via the rod ends on the torque arm.

17 & 18 TCI's kit utilizes a full-width Panhard bar to locate the axle side-to-side within the frame, and is a significant improvement over the stock suspension's stubby track bar. The Panhard bar works in conjunction with the torque arm to keep the axle centered in the frame during suspension articulation.



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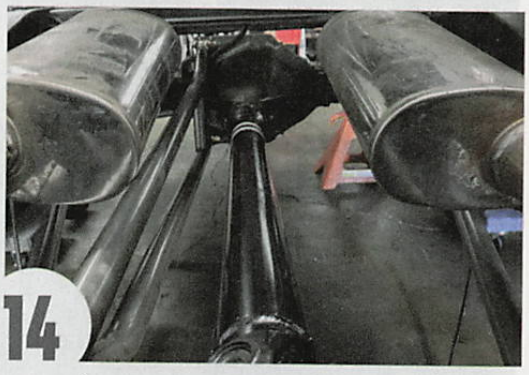

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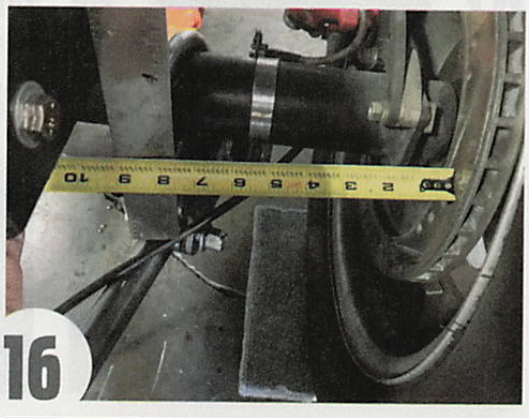

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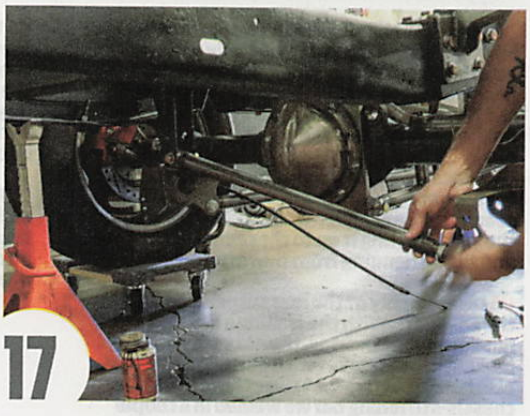

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19 Aldan American provided a set of single-adjustable shocks and 250in-lb springs with a free height of 16 inches. TCI's kit includes three mounting positions for ride height adjustments.

20 With that, the last component remaining is to mount the rear sway bar, and our C10 is finally a roller again. The next steps are to reinstall the drivetrain and execute a little body work that we've been pondering for a while.

Sources

ALDAN AMERICAN;
310.834.7478, AldanAmerican.com

CLASSIC PERFORMANCE PRODUCTS;
714.522.2000; ClassicPerform.com

TOTAL COST INVOLVED ENGINEERING;
800.984.6259; TotalCostInvolved.com

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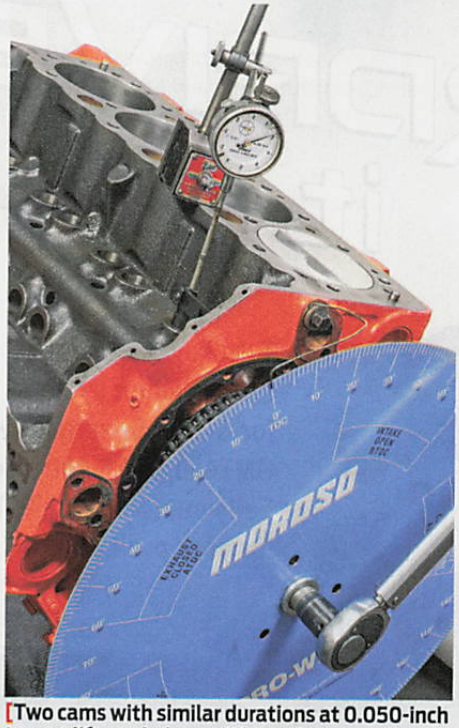
Jamie Johnson Asks...

Do Similar Duration Cams All Perform About the Same, or Differently?

Marlan Davis Marlan Davis, Comp Cams and Richard Holdener



[Two cams with similar durations at 0.050-inch tappet lift can behave differently depending on the profiles' intake and exhaust opening and closing points. The characteristics of the same cam can also change depending on whether it's installed straight-up, advanced, or retarded. At installation, always check a performance cam against its supplied timing card.

QUESTION **My favorite article is "Affordable Horsepower: Building a Low-Buck Small-Block" at HotRod.com. I like it because it shows how to get cheap, usable horsepower with lots of beautiful torque.**

I have a 355 in a 1979 Z28. From what I'm told, it has Speed Pro [pistons]; a 222/230-degree, 0.480/0.480-inch-lift cam; 305 heads with streetable porting; headers; intake; and a 650-cfm Edelbrock carb.

I would like to copy your engine setup from the article, but I have a cam question for you. The Summit K1105 cam choice is where I'm lost. It has a range of 2,400–6,000 rpm, yet it gave great numbers in such a usable range. How can this be?

There is a different cam (Comp PN 12-321-4) with similar specs but a 1,500–6,500 rpm range; will this be better, worse, or the same? Is it worth using this different cam?

[Back in 2010, Richard Holdener made nearly 420 hp and over 440 lb-ft on a 350 Chevy by swapping the cam, heads, and intake for a total claimed outlay (including core engine) of just over $1,000. This build serves as the basis for reader Johnson's inquiry.

ANSWER To get our readers up to speed, for a $1,073 outlay (in 2010 dollars) reader Johnson's referenced top-end conversion used a stock 350 pulled in the boneyard for $150 (including core charge) that, in its ultimate form, made 418 hp at 5,500 rpm and 444 lb-ft of torque at 3,800 rpm. Torque production exceeded 400 lb-ft from 2,800 rpm all the way to 5,500 rpm. Key parts included Summit's K1105 flat-tappet hydraulic cam and lifter kit, and Procomp aluminum cylinder heads, rocker arms, dual-plane intake, and gaskets.

I'm going to take you at your word that you want to duplicate as closely as possible the article's build, including the heads, intake, and the carb; and not reuse your existing top-end parts. Procomp heads have been rebranded Speedmaster, and remain quite affordable. Still close analogues to the 2010 castings, they're currently offered with 59 or 64cc chambers (instead of the 70cc volume in the original article). That raises static compression ratios about ½ to 1 point, always a good plan with cooler-running aluminum heads and larger cams.

The complete cam specs for the two cams which are the subject of your inquiry, as well as two additional modern upgrade grinds with similar durations, are in the Cam Specs table on page 76. Your two cam choices have similar intake/exhaust durations at 0.050-inch tappet lift, but different advertised durations. Summit's cam has a tad more intake valve lift than Comp, but 0.027-inch more exhaust valve lift; in fact, Comp's grind has less exhaust lift than intake lift which, by old-school standards, is uncommon. Also note the lobe separation angle (LSA) for each cam is different: a wide 114 degrees for Summit, a tight 109 degrees for Comp. The opening/closing points, the overlap, and the claimed rpm range are different for each cam; therefore, the cams won't perform the same. To get the lowdown on this very complex subject, we spoke with Comp Cam Valvetrain Engineering Group Manager Billy Godbold.

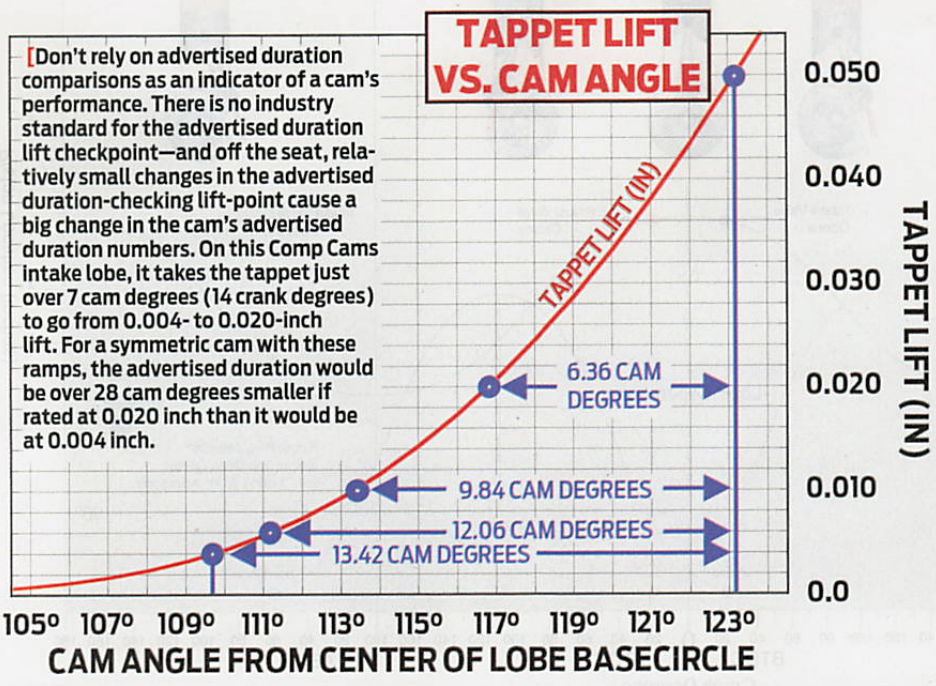
We'll start by telling you which commonly available specs are *not* reliable for a meaningful comparison. Sorry to disillusion everyone: Any cam's published "rpm range" is not reliable, especially across different manufacturers. Even within the same manufacturer, the engine's bore, stroke, rod ratio, cylinder-head flow, displacement, valvetrain weight, carburetor size, and more can affect the cam's real-world rpm operating range.

Relying on advertised duration as a basis for comparison is no better. First, different manufacturers rate the published advertised duration at different amounts of tappet lift. As Godbold puts it, "Each manufacturer uses a different Ouija board." Comp pegs advertised duration for its flat- and roller-tappet hydraulic cams at 0.006-inch; Summit doesn't publish that value. Second, the initial momentum off the cam base circle (valve seat) really depends on the lobe profile's design intent—intensity versus smoothness, for example—and is evolving as valvetrain technology evolves.

Modern lobe profile opening and closing rates can be quick, slow, or variable, as required to best match today's valvetrain parts and ensure max performance and valvetrain stability. Advertised and 0.050-inch duration are just two arbitrary points on the overall lobe shape and fail to account for subtle shape differences. This calls into question the practice of picking a cam based on so-called "intensity," or the difference between advertised duration and 0.050 duration. "Because modern, sophisticated lobe profiles may not have a constant opening and closing velocity," explains Godbold, "Even if you know *for sure* the advertised duration is at the same lift value, comparing advertised and 0.050 duration and choosing the cam where the advertised duration is closer (has less spread) to the 0.050 duration, can no longer be relied on in all cases."

Most of us don't have complete electronic lobe profilometers sitting in our garage, so what other commonly available stats can help us zero in on the performance differences in a range of cams with similar 0.050-duration numbers—the checkpoint that reflects an industry-wide common denominator? Assuming similar 0.050 duration (defined as the amount of time, expressed in crankshaft degrees, the valves are open), the cam's basic characteristics will still change due to any change in LSA (the arc of separation between the intake and lobe centerlines in

ASK MARLAN A TECH QUESTION: PITSTOP@HotRod.com Please provide a daytime phone number so we can contact you for more information if necessary. Questions will be answered in the print edition or on HotRod.com.


TAPPET LIFT VS. CAM ANGLE
[Don't rely on advertised duration comparisons as an indicator of a cam's performance. There is no industry standard for the advertised duration lift checkpoint—and off the seat, relatively small changes in the advertised duration-checking lift-point cause a big change in the cam's advertised duration numbers. On this Comp Cams intake lobe, it takes the tappet just over 7 cam degrees (14 crank degrees) to go from 0.004- to 0.020-inch lift. For a symmetric cam with these ramps, the advertised duration would be over 28 cam degrees smaller if rated at 0.020 inch than it would be at 0.004 inch.
TAPPET LIFT (IN)
6.36 CAM DEGREES
9.84 CAM DEGREES
12.06 CAM DEGREES
13.42 CAM DEGREES
0.050
0.040
0.030
0.020
0.010
0.0
TAPPET LIFT (IN)
105° 107° 109° 111° 113° 115° 117° 119° 121° 123°
CAM ANGLE FROM CENTER OF LOBE BASECIRCLE

camshaft degrees), whether the intake and exhaust centerlines (the theoretical center of each lobe between its opening and closing points, in crankshaft degrees) are advanced or retarded; the amount of overlap at TDC between the exhaust and induction strokes on a four-stroke engine when both intake and exhaust valves are open; and the opening and closing points of the intake and exhaust valves themselves.

One rough method of looking at all this is the so-called "area under the curve." Godbold explains, "If you have 10 cams with the same 0.050 duration, with the same LSA, and the same lobe centerline advance; they will pretty much make peak torque and horsepower at the same rpm point. But among those cams, those with more area over the entirety of the curve would make more power at high rpm. Primarily, this would be because the cam has more lift for the same duration. If a given lobe profile is quicker at the exhaust opening point and the intake closing point, then you will make more torque and be better at low rpm." That's the crib sheet version. What happens when LSA and/or the amount of advance is not the same?

LSA's can be classified as wide or narrow. A wide LSA (generally 113 degrees or more for a traditional small-block Chevy) is easier to tune. Idle quality is more stable; idle vacuum is higher; low-speed transition to full-throttle smoother; and, for a given static compression ratio, there is less chance of detonation. However, a wide LSA tends to move the torque and power peak rpm points slightly higher. Top-end power drop-off post-power-peak is milder. Generic street-performance cams often feature wide LSA's because they're more forgiving of nonoptimized engine and drivetrain combinations. Dedicated cams for forced-induction engines have a wide LSA to help build boost.

A tight or "narrow" LSA (109 degrees or less on a typical small-block Chevy)—assuming adequate piston-to-valve clearance and end-user tuning ability—generally improves overall performance, if performance is measured in terms of optimized torque and horsepower (not necessarily in drivability). Comparing cams with the same duration, a tight LSA makes the cam act bigger at low rpm because the additional overlap creates a bog/hesitation during transient throttle-response using generic carburetors; and smaller at high rpm because the intake closes earlier. According to Godbold, "It moves the peak horsepower number down a skosh—later exhaust opening provides a longer power stroke, so things happen a little earlier." Theoretically, you could have better low-end torque within the cam's operating range if you can overcome the initial tuning obstacles at idle and off-idle tip-in, and are willing to compensate for lower idle vacuum if running vacuum-dependent devices.

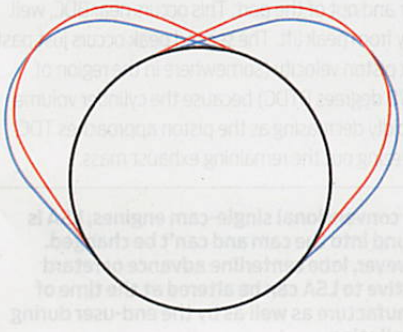
LSA and overlap go hand-in-hand. Overlap is the amount of duration, in crankshaft degrees, when both the exhaust and intake valves are open at the same time near TDC during the transition between the exhaust and induction strokes. It affects how much power and torque you will make for a given duration, and where it occurs. A wide LSA decreases overlap; a tight LSA increases it.

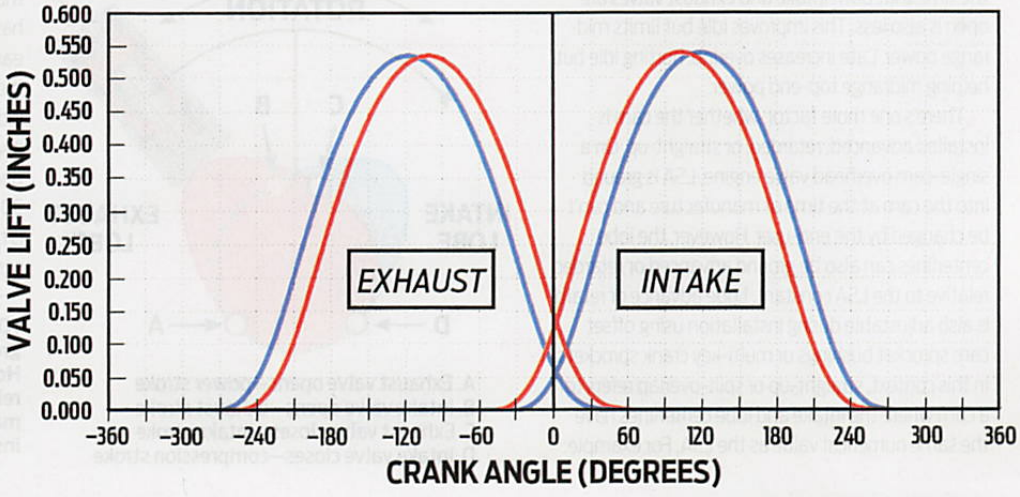
The benefit from tight LSA/more overlap is greatest with full-length tuned exhaust headers. Properly tuned headers use the exhaust wave to create a negative pressure-pulse in the next cylinder in the firing order. When the exhaust valve opens, a high-pressure wave first travels down the header tube. As soon as it hits the end of the pipe, the wave reflects back as a low-pressure wave. One of the wave harmonics comes back as a negative pulse, so during overlap this causes more suction on the intake side (aka a stronger vacuum signal), which lets intake air and fuel flow into the cylinder earlier while evacuating any residual exhaust gases quicker.

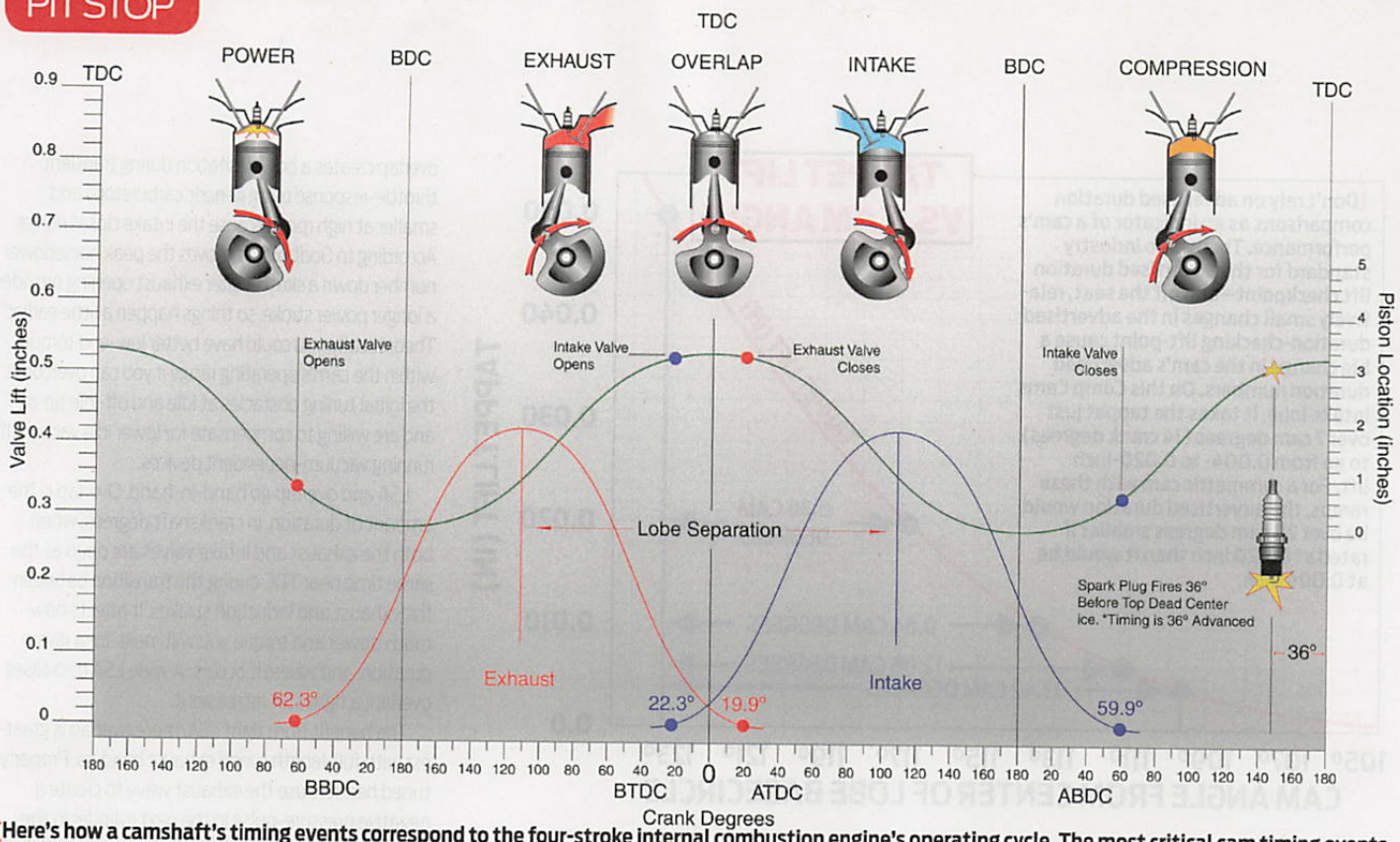
[Lobe separation angle (LSA) is the distance between the intake and exhaust centerlines measured in camshaft degrees. An engine with the same duration, but narrow LSA/more overlap, will tune optimally from just below peak torque to around peak power. It tends to make peak power slightly earlier, but post-peak power falloff is quicker than a cam with wide LSA/less overlap. A narrow LSA/greater overlap cam makes more power under the curve between the power and torque peaks. Wide LSA/less overlap idles better and makes more vacuum down low; yet peak power may occur at a slightly higher rpm.

WIDE VS. NARROW LSA

BLUE: WIDE LSA: 118 DEGREES (LESS OVERLAP)
RED: NARROW LSA: 102 DEGREES (MORE OVERLAP)







[Here's how a camshaft's timing events correspond to the four-stroke internal combustion engine's operating cycle. The most critical cam timing events are overlap, the intake closing (IC) point, and the exhaust opening (EO) point.

Overlap and LSA in turn, tie into a cam's valve opening and closing points: intake opening (IO), intake closing (IC), exhaust opening (EO), and exhaust closing (EC). Intake closing followed by exhaust opening are the most crucial. IC does the most to establish where peak torque occurs. An early IC improves low-speed torque but tends to limit high-rpm power since it allows less time for cylinder filling. A late IC offers more time for high-rpm cylinder filling but limits low-end torque, since cylinder pressure on the compression stroke may be pushed back into the intake port.

The IO point is important in establishing overlap. Early increases overlap and can cause reversion, contaminating the incoming air/fuel charge and creating tuning issues; later reduces overlap, improving idle quality and low-speed response but restricting top-end power.

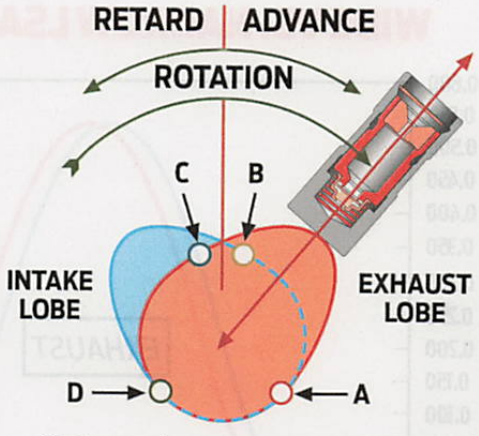
EO is nearly as important as IC. Early EO can limit low and midrange power by permitting torque-creating cylinder pressure to escape, but helps high-rpm performance by providing additional time for the exhaust gases to escape.

EC also affects overlap. Early reduces overlap, so the time that both intake and exhaust valves are open is also less. This improves idle but limits mid-range power. Late increases overlap, hurting idle but helping midrange top-end power.

There's one more factor: whether the cam is installed advanced, retarded, or straight-up. On a single-cam overhead valve engine, LSA is ground into the cam at the time of manufacture and can't be changed by the end-user. However, the lobe centerlines can also be ground advanced or retarded relative to the LSA constant. Lobe advance or retard is also adjustable during installation using offset cam sprocket bushings or multi-key crank sprockets. In this context, straight-up or split-overlap refers to a cam where the intake and lobe centerlines have the same numerical value as the LSA. For example, if a cam has a 110-degree LSA and the intake and exhaust centerlines are also 110 degrees (either as manufactured or as installed); the cam is neither advanced nor retarded. If the intake centerline is ground or installed at 106 degrees ATDC, the cam is said to be 4-degrees advanced, meaning the timing events occur earlier in the four-stroke cycle. Note that advancing the intake correspondingly advances the exhaust centerline; in this case the exhaust centerline would become 114 degrees BTDC. In old-school theory, advancing the cam supposedly compensates for timing chain stretch or provides more low-end. Modern theory holds that to achieve best overall performance in most applications, you want to center the overlap "triangle" over TDC. Depending on tolerance stack-ups in the engine, as well as whether the cam already has advance or retard ground into it, this could call for advancing, retarding, or doing nothing during the degreeing-in process.

So, what about intake/exhaust lobe-lift differences between cams of similar duration? In the old-tech world, there were no discrete intake and exhaust lobe profiles. Even if a given dual-pattern cam had different lifts and durations, the lobes themselves—in terms of intensity, acceleration, and opening and closing rates—were the same, not truly tailored to the intake side or for the exhaust side. There is a rule of thumb to increase lift a set amount along with any duration, which—on more sophisticated, old-school profiles—also correlated to valve diameter. Explains Godbold, "This can be extremely beneficial on the intake side, as the restriction from the valve can be estimated by lift divided by valve diameter (L/D). Old OEM designs ran about 20 percent L/D, where we like to see performance engines in the 25–30 percent range. But with a generic lobe that's also used interchangeably on the exhaust side, the proportional L/D increase approach is not the way to go based on modern understanding.

"We now know that on the exhaust side, two important things come into play. First, the valve diameter is much smaller, so even with the same lift you will have a much higher L/D ratio. Second, and more importantly, exhaust mass flow out the valve has two different peak points. The first occurs very early: right as you open the exhaust, where the tremendous combustion pressure 'blows down' the cylinder and out of the port. This occurs near BDC, well away from peak lift. The second peak occurs just past peak piston velocity (somewhere in the region of 30–70 degrees BTDC) because the cylinder volume is rapidly decreasing as the piston approaches TDC, squeezing out the remaining exhaust mass.



A. Exhaust valve opens—power stroke
B. Intake valve opens—exhaust stroke
C. Exhaust valve closes—intake stroke
D. Intake valve closes—compression stroke

[On conventional single-cam engines, LSA is ground into the cam and can't be changed. However, lobe centerline advance or retard relative to LSA can be altered at the time of manufacture as well as by the end-user during installation.

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Karen James is a noted journalist who specializes in relationships, romance, and sex

Ask The Expert
The inside Story on Healthy Sex!

The Amazing Secret Of A 78 Year-Old Latin Lover!

"I was shocked by his passion and energy. He took me in the bedroom like we were newleyweds - It was incredible!"

Power and Pleasure...

Lately I've received several letters from women about a "little secret" that's made their sex life absolutely explosive! This one from Tina in Texas got a little hot and spicy! (Those Texas women tell it like it is!)

Tina writes: Dear Karen,

Last month my husband came home from a business trip in Europe and shocked me with more energy and passion than he's had in years. Hard as a rock, he tossed me around the bedroom like we were newlyweds, and gave me a night I'll never forget! It was incredible - and our sex life has been like that ever since. His erections are harder than ever and spark the most intense toe-curling 'moments' I've ever had! So here we are, enjoying the best sex of our lives... in our late 50's!

On his trip, my husband stayed next to an Italian nutritionist and his wife, and heard them making loud, passionate love every single night. One afternoon, my husband asked the man his secret. The nutritionist smiled and said in broken English that he's 78 years old and after 42 years together, their sex life was still fantastico! Then he pulled a small pack from his satchel, gave it to my husband, and said "These tablets come from a small village in the north where they're cultivated organically from the most potent sexual extracts on earth. They will give you erections and a climax like you've never had before!" Then he laughed and said "You'll become an Italian Stallion, like me!"

Karen, Italian Stallion is right! But now the pack is almost empty and we both want more. Do you know about these European super-sex tablets and how to get some in the States?

Sincerely,
Tina D., Fort Worth, TX

Tina, you're in luck, I do know about them. Ever wonder why older men from Italy and all over Europe are famous for staying energized and sexually passionate well into their 80's? Well, for years, these men have relied on a unique blossom seed extract to enhance their sexual power and performance.

Milled on the fertile northern plains, and sold under the brand name Provarin, these key extracts are cultivated along the sea where pure seeds, nutrient-rich soil, and perfect weather conditions combine to deliver maximum potency.

Finely ground and pressed into tablets, these extracts have a legendary reputation throughout the European sexual underground for fueling extremely hard erections and a long, powerful climax. As Giovanni from Milan put it, "It's like bedroom rocket fuel - especially for us older guys!"

The best part from a woman's perspective is the extreme hardness and on-going power is enough to send us over the blissful edge! I found out about Provarin a few years ago when I was dating a cowboy from Wyoming. He took Provarin every morning and believe me, that good ol' boy sure rocked my nights!

All-natural Provarin is still a well-kept secret for those in the know. It's an old-school, family business and they like to keep it that way. They don't do any advertising or seek publicity. They don't need to. Long-time customers and word of mouth ensures their limited stock is sold out every year.

They do have a distributer here in the U.S. and a spokesman told me they are proud to produce the highest quality product for men and couples. He went on to say that if any of my readers call today and mention this article, they'll get a onetime 50% discount plus free shipping!

So there you go, Tina - and the rest of you readers! Just give them a call today and mention this article. The number is 1-800-519-1156.

Aren't you glad you asked?

Karen

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In sum, both exhaust flow peaks occur well away from peak exhaust lift (usually around 112-degrees BTDC for cams in the street-performance range).

"On the other hand, we know intake peak flow is always very near peak valve lift. The peak pressure difference occurs near peak piston velocity (around 75-degrees ATDC), but the mass of the incoming charge delays peak flow right into the region near max lift. The question then becomes, if you are going to make specific profiles for the intake and exhaust, why would you force added spring and cam stress to maximize peak lift on the exhaust side? At Comp, we believe it is better to try to optimize the early and late sections of the exhaust lift curve (where maximum flow is required), and only then consider max lift to optimize the cylinder head characteristics and ensure the best match for the application." In short, generic lobe profiles are the real primary reason why older cam designs tend to have more lift on the exhaust side then the intake side, and why newer, high-tech profiles now tend toward less lift on the exhaust side.

Whole books can and have been written on this subject, but the forgoing should provide a reasonable basis to analyze your cam choices. Both of your referenced profiles date from the 1990s or even earlier, so they are older technology. Although today considered a specialty grind, the Comp alternative example still uses the older, slower, High Energy lobes, but in a dual-pattern configuration, with a tight 108-degree LSA, and modern thinking concerning the exhaust lift and duration. It is ground straight-up, so to center that overlap triangle, Godbold recommends installing it on a 106-degree intake lobe centerline (2 degrees advanced). This could be worth a 10 percent improvement between 3,500 and 5,000 rpm (about 25 to 40 more lb-ft) over the generic wide LSA grind used in the 2010 build. But—you need to know how to tune it in to overcome possible off-idle drivability issues. A double-pumper, mechanical-secondary carb is mandatory. If running an automatic, install a 2,800–3,000 rpm stall-speed torque converter. Run at least 3.73:1 rear gears; otherwise, with highway gears it will probably bog on shift.

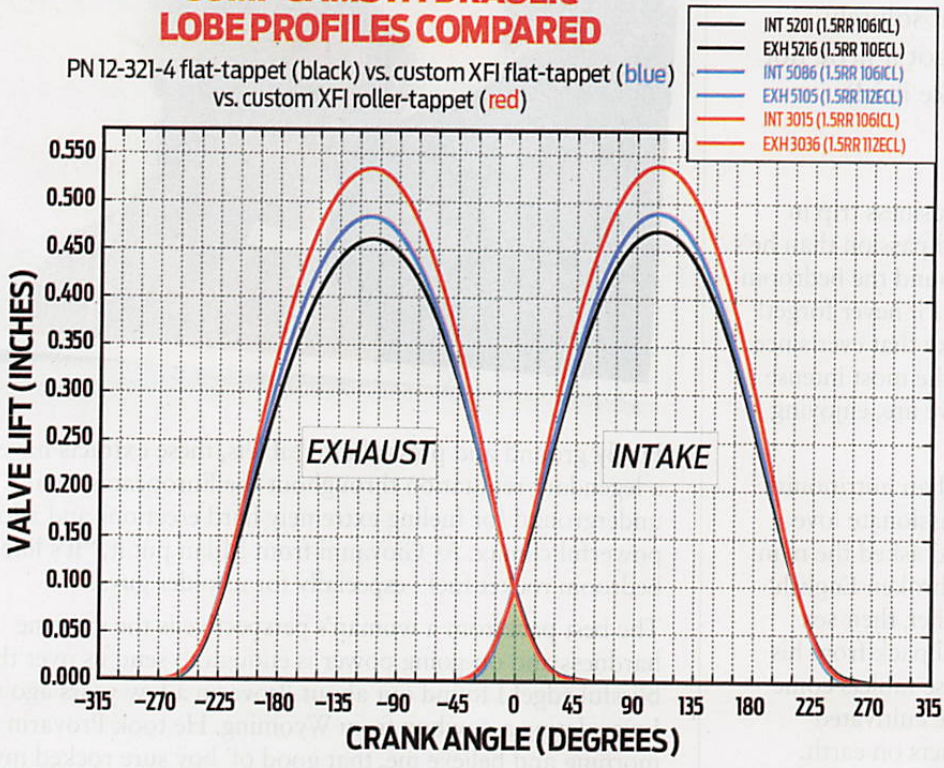
Technology never stands still. Today, there are even better choices. For the venerable classic Chevy small-block, the latest stuff isn't even in Comp's master catalog; they're that new. If building your combo around a flat-tappet block, a custom grind using Comp's XFI flat-tappet lobes at your cam's performance level has about 3 percent more area under the curve compared to your referenced High Energy grind, and could be worth another 9 hp (see the cam specs table). If not locked into an existing core, look for a factory roller-cam block (which is likely what you'll find in the wrecking yard today, anyway). Unlike flat tappets, roller tappets are reusable if in good shape, to some extent offsetting the roller cam's greater cost. An equivalent duration Comp hydraulic-roller custom grind using its new XFI roller lobes is worth 10 to 20 percent more power and torque across the board, with the exact improvement correlating to cylinder head quality. "There's also a 5 percent chance of wiping out a brand-new flat-tappet cam during initial break-in," points out Godbold.

We should note that, unlike the Summit grind that's priced as a cam and lifter kit, Comp's premium choices don't include lifters, which—at least for the flat-tappet choices—you need to account for in your budget. Whether the potential gains from more sophisticated cams are worth the added cost—including complimentary upgraded valvetrain parts and drivetrain enhancements—is something only you can decide.

One more thing: If you are thinking about keeping the existing small-valve, "street-ported 305 heads," Godbold advises that to even hope to come close to the results achieved in the article, you would need about 12 to 16 degrees more 0.050 duration on both the intake and exhaust side to maintain the same torque and rpm peak points, and even so the peak numbers will likely be down. Good luck!

COMP CAMS HYDRAULIC LOBE PROFILES COMPARED

PN 12-321-4 flat-tappet (black) vs. custom XFI flat-tappet (blue) vs. custom XFI roller-tappet (red)



[This is a plot of the three Comp cams listed in the cam specs table. All have similar 0.050 durations, LSAs, and recommended installation lobe centerlines. You can see how the area under the curve increases from Johnson's original, 1990s-era Comp Cams hydraulic flat-tappet "alternative" cam choice (black trace) to a modern Comp custom XFI flat tappet (blue), and finally to a really quick XFI hydraulic roller tappet (red). According to Comp's Godbold, current thinking is to advance or retard lobe centerlines as needed to center the "overlap triangle" over TDC (green-shaded area).

Sources

COMP CAMS; Memphis, TN; 800.999.0853 or 901.795.2400; CompCams.com

SPEEDMASTER; Rialto, CA; 909.605.1123; Speedmaster79.com

SUMMIT RACING EQUIPMENT; Akron, OH; 800.230.3030 (U.S.) or 330.630.3030 (outside U.S.); SummitRacing.com

CAM SPECS COMPARED

Listed here are specifications for the two cams listed by Johnson, as well as two current-technology cams using the latest in lobe profile science (so new they're not even in the current master catalog). All values in degrees, unless stated otherwise.

MFR.	TYPE	SERIES	GRIND	PART NO.	LOBE LOCATION	LIFT (INCHES)		TAPPET DURATION		TIMING, 0.050" TAPPET-LIFT			LOBE POSITION			SUMMIT PRICE[2]
						LOBE	VALVE (1.5:1 RATIO)	ADVERTISED[1]	0.050" LIFT	OPEN	CLOSE	OVERLAP	INSTALLED CENTERLINE	LSA	ADVANCE	
Summit Racing	Hydraulic flat	Summit Classic	–	SUM-K1105[3]	Intake	0.311	0.466	298	224	3 BTDC	41 ABDC	1	109	114	+5	$111.99
					Exhaust	0.325	0.487	304	234	56 BBDC	2 BTDC		119			
Comp Cams	Hydraulic flat	High Energy	Z70AH-8	12-321-4	Intake	0.313	0.470	270	224	6 BTDC	38 ABDC	11	106	108	+2	$152.99
					Exhaust	0.306	0.460	280	230	45 BBDC	5 ATDC		110			
	Hydraulic flat	Xtreme Energy XFI	Custom	12-000-5CS 5086S / 5105S H109 (+3)	Intake	0.326	0.490	267	224	6 BTDC	38 ABDC	10	106	109	+3	$199.99
					Exhaust	0.323	0.484	279	231	48 BBDC	4 ATDC		112			
	Hydraulic roller	Xtreme Energy XFI	Custom	08-000-8CS 3015S / 3036S HR109 (+3)	Intake	0.359	0.538	273	224	6 BTDC	38 ABDC	9	106	109	+3	$308.99
					Exhaust	0.356	0.534	281	230	47 BBDC	3 ATDC		112			

NOTES: [1]Hydraulic cam advertised duration tappet-lift check-point is 0.006" for Comp; not specified for Summit. [2]Checked 11/19/19 at Summit Racing and subject to change. [3]Listed Part No. is for cam and lifter kit; all others are cam only.

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Modern Driveline // 208.453.9800 // moderndriveline.com

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Price: $495

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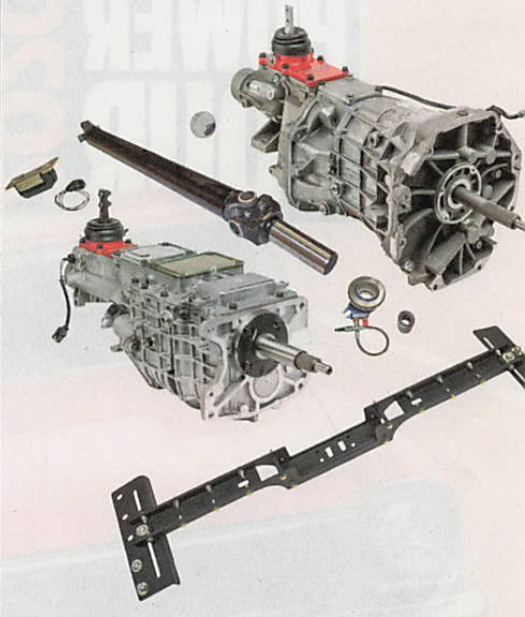
American Powertrain // 931.646.4836 // americanpowertrain.com

The new ProFit five- and six-speed system for the '78–'88 GM G-body is now available and is ideal if you're looking for better fuel economy, low-rpm cruising, reduced engine wear, and better performance. And, frankly, who isn't? The system is built around the TREMEC TKO five-speed and dual overdrive Magnum six-speed transmissions, and the kit includes a custom, adjustable crossmember, custom high-strength driveshaft, transmission mount, offset shifter, and speedo solution. The company also offers a G-body hydraulic clutch kit.

Price: Contact for quote



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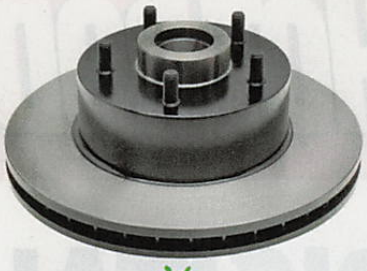

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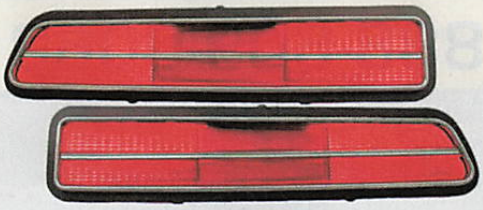

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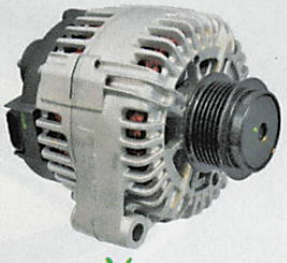

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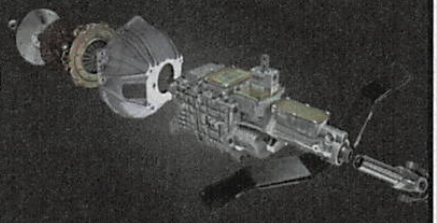

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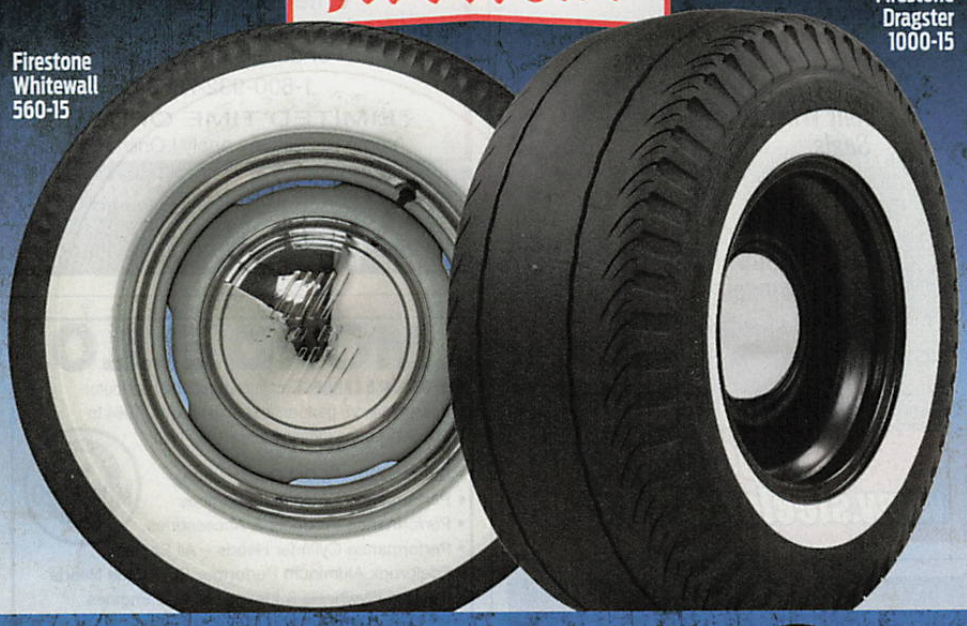

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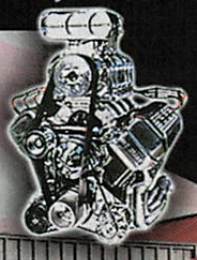

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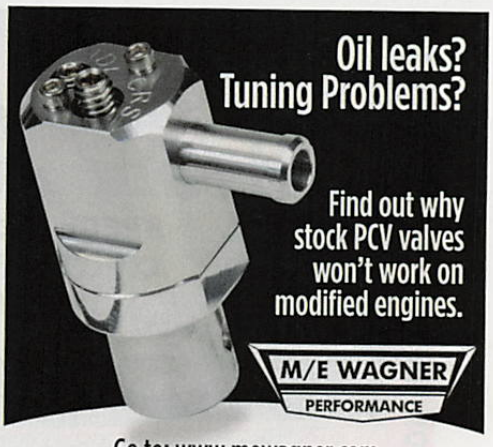

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Chip Off the Old Block

By David Freiburger

Roadkill
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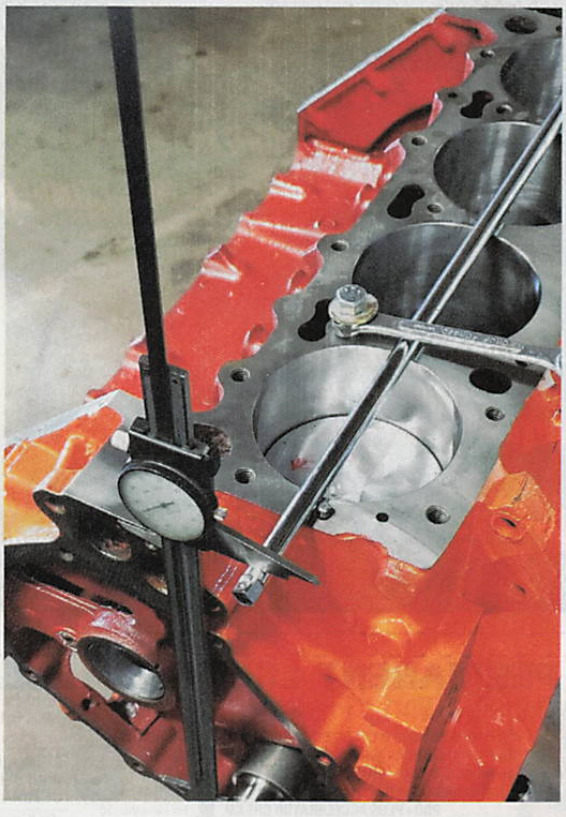
There's that moment when you realize the sickness is terminal. For me, the lead-up began on April 15, 1983, when—at 15 years old—I bought my 1970 Dodge Super Bee. It was loaded with a hopped-up 383 B engine that wasn't a numbers-matching casting for the car, but it was a big-block nonetheless. It did a lot of burnouts, and that was all I needed.

The 383 was the first engine I ever rebuilt, and I did the work in auto shop as a junior in high school under the direction of Mr. Quentin Swan, a Central Casting figure of a '50s reserve cop and straight-laced auto mechanic. One day I was all set to fire up that freshly dingle-balled and ring-'n'-bearing'd 383 when we decided to start it and break in the cam the next day. I set off to walk home from school—then got hit by a VW Rabbit, splintering my left humerus from top to bottom. While I was in the hospital for a week plus, my friends got the Super Bee running and delivered it to my house as I was recovering.



With an agricultural but effective technique, this was the necropsy that revealed the final moments of my beloved engine block.

The refreshed 383 ran meager 15.80s at LACR, but it took me drag racing in my own car for the first time. Soon, the longing for a mighty 440 was too strong, and I spent all my cash from my parts-counter job at the Dodge dealer building a Six Pack long-block I'd bought out of the *Recycler* classifieds and using a formula from a HOT ROD magazine article. By early 1988, the 383 had found its way to the quiet, lonely bottom of a pile of parts in a corner of the garage floor. It moldered for 18 years.

Eventually, all iron emerges from my garage like the phoenix. One midnight in a dark alley, Steve Dulcich and I woke the neighbors, clanging an engine hoist's steel wheels over rough concrete for the 383's prison break. It was soon at the machine shop, assembled, and on the dyno, being used for HOT ROD's two Mopar intake-manifold shootouts in late 2007 and early 2008.

Next, we gave it more compression, then discovered the lessons of having too much piston dome getting in the way of the combustion path. Dulcich used a wood router to flawlessly mill 0.100 off of the solid-dome pistons, and we made more power with less compression thanks to a lower dome. Education never ends.

Then, in 2012, I started doing a show called *Roadkill*. In season four, we began building a '70 Plymouth Duster that Dulcich and I had traded back and forth. It had sunken into the ground at his vineyard, and hence became known as the Crop Duster. Initially we threw a motorhome 440 RB engine into the car, but quickly learned to love the lower deck height of the B-engine big-blocks. The intrepid 383 was called back from the reserves. After a couple episodes of the spinoff called *Roadkill Garage*—hosted by Dulcich and me—we had my first engine block, crank, and rods in the car and were running 11.70s naturally aspirated, and we were pretty happy.

Happy enough to decide to tear apart the Crop Duster for a paint job. Also discontent enough to decide that the 383 should really make more power. We started with porting some heads, then mission creep ended with a stroker kit for 439ci from my old friend the 383 engine block. I began to realize that I was excessively gearheaded, sentimental, and perhaps off my rocker when I was sad to see the end of use for that old crank and connecting rods that had been with me since 1983.

But then terminal moment came—for me, if not for the 383. In December of 2019, Dulcich began to assemble the new stroker combo after picking up the 383 block from the machine shop. Disaster struck. The pistons wound up 0.065-inch above the deck. The machinist had transposed a number when milling the block. After nearly 37 years—including my first rebuild, my first street races, my first dragstrip victories, some great magazine stories, and life in two different project cars—my trusty 383 block is junk. Killed by a clerical error.

This mattered to me a lot. I realized I'd become emotionally attached not to the car, but to a lifeless, replaceable hunk of antiquated cast iron. But the thing had brought me this far through my hot rodding life. I wanted to cry. I mean, Dulcich is going to put it together with some 0.098-inch thick MLS head gaskets, and it'll run again, but it's been deflowered in my eyes. It'll never be the same. It's like someone shot my dog. And in that moment, I realized that my sickness is terminal.

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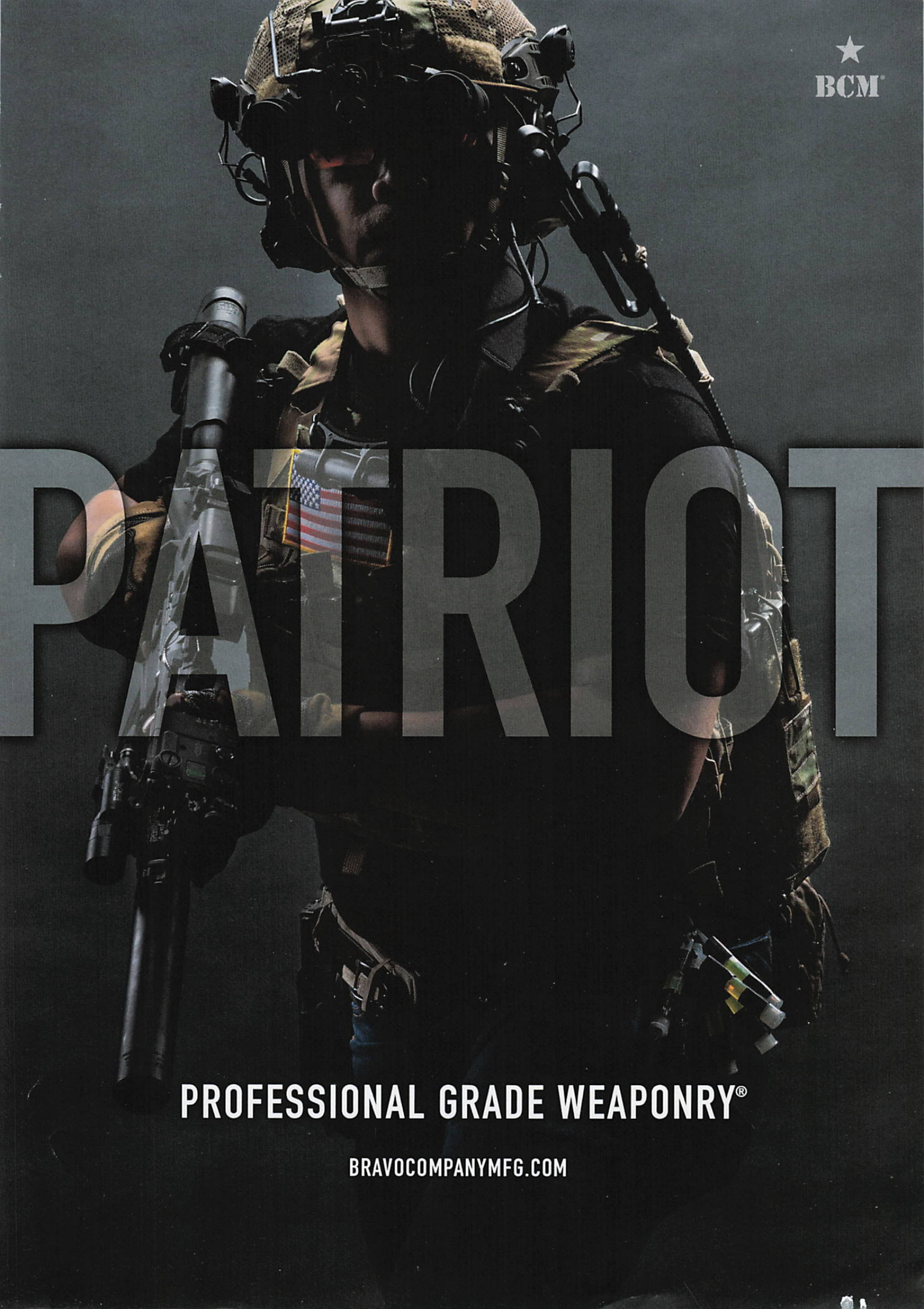
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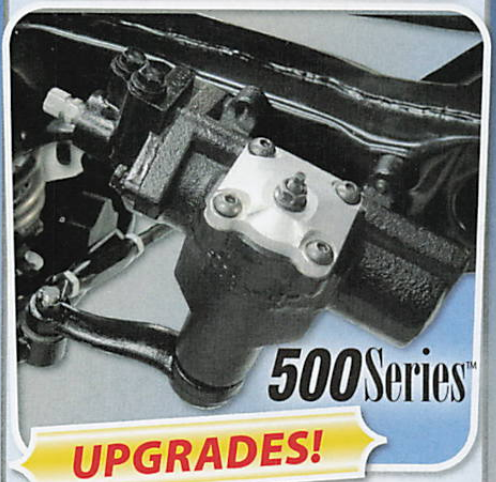

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